

DRAFT
Chesapeake Bay Total Maximum Daily Load

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and in collaboration with

Delaware, Maryland, New York,
Pennsylvania, Virginia,
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Draft Chesapeake Bay TMDL Executive Summary

Introduction

The U.S. Environmental Protection Agency has released the draft Chesapeake Bay Total Maximum Daily Load (TMDL), a “pollution diet” that will compel sweeping actions to restore the Chesapeake Bay and its vast network of streams, creeks and rivers.

The TMDL was prompted by insufficient restoration progress over the last several decades in the Bay. The TMDL is required under federal law and responds to consent decrees in Virginia and D.C. dating back to the late 1990s. It is also a keystone commitment of a federal strategy to meet President Obama’s Executive Order to restore and protect the Bay.

The draft TMDL – the largest ever developed by EPA – includes pollution limits to meet water quality standards in the Bay and its tidal rivers. The TMDL is designed to ensure that all pollution control measures to fully restore the Bay and its tidal rivers are in place by 2025, with 60 percent of the actions completed by 2017. The final TMDL will be established December 31.

On July 1, EPA set draft Bay watershed limits for nitrogen and phosphorus at 187.4 million and 12.5 million pounds per year, respectively, and on Aug. 13 set a range of allowable sediment pollution levels at between 6.1 and 6.7 billion pounds per year. These pollution limits were further divided by jurisdiction and major river basin based on state-of-the-art modeling tools, extensive monitoring data, peer-reviewed science, and close interaction with state partners.

The TMDL is supported by accountability measures to ensure cleanup commitments are met, including short-and long-term benchmarks, a tracking and accounting system, and additional federal backstop measures, if necessary, to spur progress.

EPA incorporated federal backstop measures into the draft TMDL because of deficiencies in the majority of draft pollution reduction plans submitted by the states and District of Columbia in early September. Most of these draft Watershed Implementation Plans (WIPs) did not identify programs to sufficiently reduce pollution to meet TMDL allocations and provide assurance the programs could be implemented. As a result, EPA’s backstop measures focus on tightening controls on federally permitted point sources of pollution, such as wastewater treatment plants, large animal agriculture operations and municipal stormwater systems.

EPA proposed more extensive backstop allocations for Pennsylvania, Virginia, New York, Delaware and West Virginia. Only minor changes were made to the plans for Maryland and the District of Columbia. The jurisdictions will have the opportunity to revise and strengthen their plans before final versions are due on November 29. During this time, EPA will engage jurisdictions to share best approaches from the WIPs across the jurisdictions and provide EPA guidance on the most effective pollution controls. When those final WIPs are submitted, EPA will again evaluate the plans to determine if EPA backstop allocations can be replaced with sufficiently improved state commitments.

The release of the draft TMDL begins a 45-day public comment period that will include 18 public meetings in all six watershed states and the District of Columbia. The public meeting

schedule, including registration links for webinars, is at <http://www.epa.gov/chesapeakebaytmdl>. The website provides instructions for accessing the draft TMDL and providing comments.

TMDL Background

The Clean Water Act sets as a goal that all waters in the United States be “fishable” and “swimmable,” and requires states and the District of Columbia to establish water quality standards to measure the health of water bodies relative to these primary environmental goals. The Clean Water Act also requires jurisdictions to develop a list of waterways that are impaired by pollutants and do not meet water quality standards. A Total Maximum Daily Load (TMDL) must be developed for certain waterways on the impaired list. A TMDL is essentially a “pollution diet” that identifies the maximum amount of a pollutant the waterway can receive and still meet water quality standards.

Most of the Chesapeake Bay and its tidal waters are listed as impaired because of excess nitrogen, phosphorus and sediment. These pollutants cause algae blooms that consume oxygen and create “dead zones” where fish and shellfish cannot survive, block sunlight that is needed for underwater grasses, and smother aquatic life on the bottom. The high levels of nitrogen, phosphorus and sediment enter the water from agricultural operations, urban and suburban runoff, wastewater facilities, air pollution and other sources, including septic systems. Despite some reductions in pollution during the past 27 years of restoration due to extensive efforts by federal, state and local governments; non-governmental organizations; and stakeholders in the agriculture, urban/suburban and wastewater sectors, there has been insufficient progress toward meeting the water quality goals for the Chesapeake Bay and its tidal waters.

Since 2000, the seven jurisdictions in the Chesapeake Bay watershed (Delaware, District of Columbia, Maryland, New York, Pennsylvania, Virginia, and West Virginia) and the U.S. Environmental Protection Agency, who along with the Chesapeake Bay Commission are partners in the Chesapeake Bay Program, have been planning for a Chesapeake Bay TMDL.

Since September 2005, the seven jurisdictions have been actively involved in decision-making to develop the TMDL. In the October 2007 meeting of the Chesapeake Bay Program’s Principals’ Staff Committee, the jurisdictions and EPA agreed that EPA would establish the TMDL. Since 2008, EPA has sent official letters to the jurisdictions detailing all facets of the TMDL, including: schedules for developing the TMDL and pollution reduction plans, EPA’s expectations and evaluation criteria for jurisdiction plans to meet the TMDL pollution limits, reasonable assurance for controlling nonpoint source pollution, and backstop actions that EPA could take to ensure progress.

The TMDL also resolves commitments made in a number of consent decrees, Memos of Understanding, and settlement agreements dating back to the late 1990s that address certain waters identified as impaired in the District of Columbia, Delaware, Maryland and Virginia.

Additionally, President Obama issued Executive Order 13508 on May 12, 2009, which directed the federal government to lead a renewed effort to restore and protect the Chesapeake Bay and its watershed. The Chesapeake Bay TMDL is a keystone commitment in the strategy developed by federal agencies to meet the President’s Executive Order.

More than 40,000 TMDLs have been completed across the United States, but the Chesapeake Bay TMDL will be the largest and most complex thus far – it is designed to achieve significant reductions in nitrogen, phosphorus and sediment pollution throughout a 64,000-square-mile watershed that includes the District of Columbia and large sections of six states. The TMDL is actually a combination of 92 smaller TMDLs for individual Chesapeake Bay tidal segments and includes pollution limits that are sufficient to meet state water quality standards for dissolved oxygen, water clarity, underwater grasses and chlorophyll-*a*, an indicator of algae levels. It is important to note that the pollution controls employed to meet the TMDL will also have significant benefits for water quality in the tens of thousands of streams, creeks and rivers throughout the region. EPA will establish the final Chesapeake Bay TMDL, after considering public comments and additional input from the jurisdictions, by December 31, 2010.

Developing the Chesapeake Bay TMDL

Development of the Chesapeake Bay TMDL required knowledge of the stream flow characteristics of the watershed, sources of pollution, distribution and acreage of the various land uses, appropriate best management practices, the transport and fate of pollutants, precipitation data and many other factors. The TMDL uses a series of models, calibrated to decades of water quality and other data, and refined based on input from dozens of Chesapeake Bay scientists. Modeling is an approach that uses observed and simulated data to replicate what is occurring in the environment, and was a critical and valuable tool to develop the Chesapeake Bay TMDL.

The development of the TMDL consisted of three major steps.

1. EPA provided allocations to the jurisdictions and major basins for nitrogen, phosphorus and sediment.
2. Jurisdictions developed draft Phase 1 Watershed Implementation Plans to achieve those basin-jurisdiction allocations. In these WIPs, jurisdictions made decisions on how to further sub-allocate the basin-jurisdiction loadings to various individual point sources and a number of point and nonpoint source sectors.
3. EPA evaluated the draft WIPs and where deficiencies existed, EPA provided backstop allocations in the draft TMDL that consisted of a hybrid of the jurisdiction WIP allocations modified by EPA allocations for some source sectors to fill gaps in the WIPs.

These draft TMDL loadings to the basin-jurisdictions are provided in table ES-1. These loadings were determined using the best peer-reviewed science and through extensive collaboration with the jurisdictions and informed by the Watershed Implementation Plans.

Table ES-1. Chesapeake Bay TMDL watershed nutrient and sediment draft allocations by jurisdiction and by major river basin [proposed standards]

Jurisdiction	Basin	Nitrogen draft allocations (million lbs/year)	Phosphorus draft allocations (million lbs/year)	Sediment draft allocations (million lbs/year)
Pennsylvania	Susquehanna	71.74	2.31	1,758.20
	Potomac	4.72	0.42	233.93
	Eastern Shore	0.28	0.01	21.12
	Western Shore	0.02	0.001	0.37
	PA Total	76.77	2.74	2,013.62
Maryland	Susquehanna	1.08	0.05	62.94
	Eastern Shore	9.71	1.09	169.70
	Western Shore	9.74	0.46	170.38
	Patuxent	2.85	0.21	90.12
	Potomac	15.70	0.90	682.33
	MD Total	39.09	2.72	1,175.47
Virginia	Eastern Shore	1.21	0.16	10.91
	Potomac	17.46	1.47	810.07
	Rappahannock	5.84	0.90	688.51
	York	5.41	0.54	107.09
	James	23.48	2.34	852.77
	VA Total	53.40	5.41	2,469.35
District of Columbia	Potomac	2.32	0.12	11.16
	DC Total	2.32	0.12	11.16
New York	Susquehanna	8.23	0.52	292.96
	NY Total	8.23	0.52	292.96
Delaware	Eastern Shore	2.95	0.26	57.82
	DE Total	2.95	0.26	57.82
West Virginia	Potomac	4.67	0.74	248.11
	James	0.02	0.01	16.65
	WV Total	4.68	0.75	264.76
Total Basin/Jurisdiction Draft Allocation		187.44	12.52	6,285.14
Atmospheric Deposition Draft Allocation		15.70	--	--
Total Basinwide Draft Allocation		203.14	12.52	6,285.14

a. Cap on atmospheric deposition loads direct to Chesapeake Bay and tidal tributary surface waters to be achieved by federal air regulations through 2020.

Since nitrogen and phosphorus loadings from all parts of the Bay watershed have an impact on most segments of the Bay, it was necessary for EPA to allocate the nitrogen and phosphorus loadings in an equitable manner to the states and basins. There were 3 basic guides that were used to divide these loads.

- Allocated loads should protect living resources of the Bay and its tidal tributaries and result in all segments of the Bay mainstem, tidal tributaries and embayments meeting water quality standards for dissolved oxygen, chlorophyll a, water clarity and underwater grasses.
- Tributary basins that contribute the most to the Bay water quality problems must do the most to resolve those problems (on a pound per pound basis).
- All tracked and reported reductions in nitrogen, phosphorus and sediment loads are credited toward achieving final assigned loads.

In addition, EPA is committing to reducing air deposition of nitrogen to the tidal waters of the Chesapeake Bay to 15.7 million pounds per year. The reductions will be achieved through implementation of federal air regulations during the coming years.

To insure that these pollutant loadings will attain and maintain water quality standards, the TMDL calculations were developed to account for critical environmental conditions a waterway would face, future growth, and seasonal variation. An implicit margin of safety was also included in the TMDL.

The TMDL is designed to ensure that by 2025 all practices necessary to fully restore the Bay and its tidal river are in place, with 60 percent of the actions taken by 2017.

As mentioned above, a TMDL must be based on achieving established state water quality standards. In the case of the Bay TMDL, as the TMDL is being developed, the state water quality standards are being proposed for modification. So the loadings allocated to the states as identified above and the state WIPs are based on loadings to achieve the proposed state standards.

However, the Chesapeake Bay TMDL document also provides allocations for attaining the current water quality standards. In order to achieve the current standards, the allocations happen to be more stringent than the allocations identified above. This set of TMDL allocations are important if the state standards are not modified before the completion of the Bay TMDL.

Furthermore, this TMDL provides information on the pollution control levels for a full backstop TMDL, in case such controls are needed in the final TMDL.

EPA expects that the water quality standards and state WIPs are likely to change before this TMDL is finalized. So offering information on possible TMDL loadings under each of these options provides EPA with the flexibility, informed by the final WIPs and public comment, to finalize this TMDL based on the relevant information at the time the TMDL is finalized. And the final TMDL allocations could range from full WIP based loads to full backstop loads, depending on the strength of the final state WIPs.

Accountability and Goals

The Chesapeake Bay TMDL is unique because of the extensive measures included to ensure accountability for reducing pollution and meeting deadlines for progress. The TMDL will be implemented using an accountability framework that includes Watershed Implementation Plans (WIPs), two-year milestones, EPA's tracking and assessment of restoration progress and, as

necessary, specific federal backstop actions if the jurisdictions do not meet their commitments. The accountability framework is being established in part to provide demonstration of the reasonable assurance provisions of the Chesapeake Bay TMDL pursuant to both the Clean Water Act and the Chesapeake Bay Executive Order, but is not part of the TMDL itself.

When EPA establishes or approves a TMDL that allocates pollutant loads to both point and nonpoint sources, it determines whether there is a “reasonable assurance” that the nonpoint source load allocations will be achieved and water quality standards will be attained. Reasonable assurance for the Chesapeake Bay TMDL is provided by the numerous federal, state and local regulatory and non-regulatory programs identified in the accountability framework that EPA believes will result in the necessary point and nonpoint source controls and pollutant reduction programs. The most prominent program is the CWA’s National Pollutant Discharge Elimination System (NPDES) permit program that regulates point sources throughout the nation. Many nonpoint sources are not covered by a similar federal permit program; as a result, financial incentives and other voluntary programs are used to achieve nonpoint source reductions. These federal tools are supplemented by a variety of state regulatory and voluntary programs and other commitments of the federal government set forth in the Executive Order strategy and identified in the accountability framework discussed above.

Beginning in 2012, jurisdictions (including the federal government) are expected to develop two-year milestones to track progress toward reaching the TMDL’s goals. In addition, the milestones will demonstrate the effectiveness of the jurisdictions’ WIPs by identifying specific near-term pollutant reduction controls and a schedule for implementation (see next section for further description of WIPs). EPA will review these two-year milestones and evaluate whether they are sufficient to achieve necessary pollution reductions and, through the use of a Bay Tracking and Accountability System, determine if milestones are met.

If a jurisdiction’s plans are inadequate or its progress is insufficient, EPA can invoke a suite of backstop actions to ensure pollution reductions. These include expanding coverage of NPDES permits to sources that are currently unregulated, increasing oversight of state-issued NPDES permits, requiring additional pollution reductions from point sources such as wastewater treatment plants, increasing federal enforcement and compliance in the watershed, prohibiting new or expanded pollution discharges, redirecting EPA grants, and revising water quality standards to better protect local and downstream waters.

Watershed Implementation Plans

The cornerstone of the accountability framework is the jurisdictions’ development of Watershed Implementation Plans (WIPs), which serve as roadmaps for how and when a jurisdiction plans to meet its pollution allocations under the TMDL. In their draft Phase I WIPs, the jurisdictions were expected to subdivide the Bay TMDL allocations among pollutant sources; evaluate their current legal, regulatory, programmatic and financial tools available to implement the allocations; identify and rectify potential shortfalls in attaining the allocations; describe mechanisms to track and report implementation activities; provide alternative approaches; and outline a schedule for implementation.

EPA provided the jurisdictions with detailed expectations for WIPs in November 2009 and April 2010. To assist with WIP preparation, EPA provided considerable technical and financial assistance. Also last year, EPA announced target loads to allow the jurisdictions to begin developing WIPs. EPA worked with the jurisdictions to evaluate various “what if” scenarios – combinations of practices and programs that could achieve their pollution allocations.

After the draft Phase I WIP submittal deadline of September 1, a team of EPA sector experts conducted an intense evaluation process, comparing the submissions with EPA expectations. Two goals were paramount in the EPA WIP review: achieving the basin-jurisdiction pollution allocations and providing a high level of assurance that reductions would be achieved, particularly for non-permitted sources like runoff from agricultural lands and currently unregulated stormwater from urban and suburban lands.

The EPA evaluation concluded that the pollution controls identified in two of the seven jurisdictions’ WIPs could meet nitrogen and phosphorus allocations and five of the seven jurisdictions’ WIPs could meet sediment allocations for the jurisdiction as a whole. The evaluation by jurisdiction is:

- **Maryland:** Some deficiencies – Meets overall statewide allocations for nitrogen (at allocation), phosphorus (at allocation) and sediment (0 percent under), but several individual river basins exceed the allocations for nitrogen, phosphorus or sediment.
- **District of Columbia:** Some deficiencies – Meets allocation for nitrogen (5 percent under) and phosphorus (3 percent under), but does not meet the sediment allocation (25 percent over).
- **Delaware:** Serious deficiencies – Does not meet allocations for nitrogen (17 percent over) and phosphorus (8 percent over), but does meet allocations for sediment (20 percent under).
- **New York:** Serious deficiencies – Does not meet allocations for nitrogen (15 percent over) and phosphorus (14 percent over), but does meet allocations for sediment (17 percent under).
- **Pennsylvania:** Serious deficiencies – Does not meet allocations for nitrogen (0 percent under) and phosphorus (11 percent over), but does meet allocations for sediment (1 percent over).
- **Virginia:** Serious deficiencies – Does not meet allocations for nitrogen (6 percent over) and phosphorus (7 percent over), but does meet allocations for sediment (12 percent under).
- **West Virginia:** Serious deficiencies – Does not meet allocation for nitrogen (18 percent over) or sediment (38 percent over), but does meet the allocation for phosphorus (6 percent under).

The EPA evaluation also concluded that none of the seven WIPs provided sufficient reasonable assurance that pollution controls identified could actually be implemented to achieve the nitrogen, phosphorus and sediment reduction targets by 2017 or 2025. The shortfalls of the WIPs, which varied by jurisdiction, included:

- Vague or no strategy for filling recognized program or resources gaps
- Few enforceable or otherwise binding commitments

- Discrepancies between implementation levels in model input decks and strategies described in WIP
- Reliance on pollution trading programs but no commitment to adopt critical trading drivers such as new regulations
- Few dates for key actions and program-building milestones

EPA Backstop Allocations

Once EPA evaluated a WIP and found shortfalls in pollution loading reductions and/or assurance that reductions would be achieved, EPA included only the parts of the WIP that it determined to be adequate and appropriate in its TMDL allocation. EPA then determined how to make up that shortfall and/or insufficient amount of reasonable assurance for the remainder of the allocation. EPA considered varying levels of federal backstop allocations that adjusted loads delivered to the Bay to ensure water quality standards are met. The result is a draft TMDL that merges jurisdictions' WIP allocations with varying degrees of federal backstop allocations in all seven jurisdictions, as well identification of additional federal actions that EPA is prepared to take if jurisdictions do not achieve milestones on schedule. For the most part in making the hybrid allocations, EPA decreased the allocations to the point sources (over which EPA has or could assert regulatory control) and increased the load allocations to unregulated nonpoint sources. EPA identified backstop allocations at three levels:

- **Minor:** EPA adjusted WIP pollution sector allocations to achieve the jurisdiction's overall and major river basin nitrogen, phosphorus and sediment allocations.
- **Moderate:** WIP aggregate point source allocations for stormwater and animal agriculture (CAFO) sectors were adjusted to equate to the best approach that was proposed and determined adequate in other jurisdiction WIPs. More stringent wasteload allocations were applied to point source wastewater sources (regulated via federal programs); other nonpoint source allocations increased as feasible if there was insufficient assurance that reductions would be achieved.
- **High:** WIP aggregate allocations for point source stormwater and animal agriculture sectors were adjusted downward to equate to the best approach that was proposed and determined adequate in other jurisdiction WIPs; Very stringent wastewater allocations were applied to point source wastewater sources based on limit of technology concentrations (regulated via federal programs); other nonpoint source allocations increased as feasible if there was insufficient assurance that reductions would be achieved.

Backstop allocations focus on areas where EPA has the federal authority to control pollution allocations through NPDES permits. These backstops involve substituting a jurisdiction's proposed point source allocations with more stringent EPA "backstop allocations" for point sources including wastewater treatment plants, stormwater permits, and animal agriculture operations. The draft TMDL reflects the following level of backstops for each jurisdiction:

- **Maryland: Minor-level backstop allocations** primarily for Maryland's nonpoint source load allocations to meet nitrogen, phosphorus and sediment allocations in each major basin within Maryland. No changes to point source wasteload allocations that would affect NPDES permit conditions.

- **District of Columbia: Minor-level backstop allocations** to District of Columbia's wasteload allocations for urban stormwater so that the District meets upper range of sediment allocation. EPA will ensure that all allocations, including sediment, are met through the NPDES permits issued within the District.
- **Virginia: Moderate-level backstop allocations** for Virginia point sources
 - Wastewater treatment plants: 4 mg/L TN and .3 mg/L TP and design flow for significant municipal plants consistent with most aggressive WIP proposal (Maryland ENR Strategy).
 - MS4s: 50 percent of urban MS4 lands meet aggressive performance standard through retrofit/ redevelopment; 50 percent of unregulated land treated as regulated, so that 25 percent of unregulated land meets aggressive performance standard; designation as necessary.
 - Construction: Erosion and sediment control on all lands subject to Construction General Permit.
 - CAFO production areas: Waste management, barnyard runoff control, mortality composting. Precision feed management for all animals. Same standards apply to AFOs not subject to CAFO permit except no feed management on dairies; designation as necessary.
 - Additional adjustments to agriculture nonpoint sources as necessary to exactly meet nitrogen, phosphorus and sediment allocations.
- **Delaware: High-level backstop allocations** for Delaware point sources
 - Wastewater treatment plants: limit of technology (3 mg/L TN and .1 mg/L TP) and design flow for significant municipal plants.
 - MS4s: 50 percent of urban MS4 lands meet aggressive performance standard through retrofit/ redevelopment; 50 percent of unregulated land treated as regulated, so that 25 percent of unregulated land meets aggressive performance standard; designation as necessary.
 - Construction: Erosion and sediment control on all lands subject to Construction General Permit.
 - CAFO production areas: Waste management, barnyard runoff control, mortality composting. Precision feed management for all animals. Same standards apply to AFOs not subject to CAFO permits except no feed management on dairies; designation as necessary.
 - Additional reductions from agricultural nonpoint sources necessary to meet nitrogen and phosphorus allocations that EPA will ensure occurs through additional federal backstop actions.
- **New York: High-level backstop allocations** for New York point sources
 - Wastewater treatment plants: limit of technology (3 mg/L TN and .1 mg/L TP) and design flow for significant municipal plants.
 - MS4s: 50 percent of urban MS4 lands meet aggressive performance standard through retrofit/ redevelopment; 50 percent of unregulated land treated as regulated, so that 25 percent of unregulated land meets aggressive performance standard; designation as necessary.

- Construction: Erosion and sediment control on all lands subject to Construction General Permit.
- CAFO production areas: Waste management, barnyard runoff control, mortality composting. Precision feed management for all animals. Same standards apply to AFOs not subject to CAFO permits except no feed management on dairies; designation as necessary.
- Additional reductions from agricultural nonpoint sources necessary to meet nitrogen, phosphorus and sediment allocations that EPA will ensure occurs through additional federal backstop actions.
- Finer scale wasteload and load allocations (same level of detail as tidal states) to ensure NPDES permits will be consistent with Chesapeake Bay TMDL wasteload allocations.
- **Pennsylvania: High-level backstop allocations** for Pennsylvania point sources
 - Wastewater treatment plants: limit of technology (3 mg/L TN and .1 mg/L TP) and design flow for significant municipal plants.
 - MS4s: 50 percent of urban MS4 lands meet aggressive performance standard through retrofit/ redevelopment; 50 percent of unregulated land treated as regulated, so that 25 percent of unregulated land meets aggressive performance standard; designation as necessary.
 - Construction: Erosion and sediment control on all lands subject to Construction General Permit.
 - CAFO production areas: Waste management, barnyard runoff control, mortality composting. Precision feed management for all animals. Same standards apply to AFOs not subject to CAFO permits except no feed management on dairies; designation as necessary.
 - Load from point source reductions redistributed to forest, septic, and agriculture sources as possible while still meeting nitrogen, phosphorus and sediment allocations.
 - Finer scale wasteload and load allocations (same level of detail as tidal states) to ensure NPDES permits will be consistent with Chesapeake Bay TMDL wasteload allocations.
- **West Virginia: High-level backstop allocations** for West Virginia point sources
 - Wastewater treatment plants: limit of technology (3 mg/L TN and .1 mg/L TP) and design flow for significant municipal plants.
 - MS4s: 50 percent of urban MS4 lands meet aggressive performance standard through retrofit/ redevelopment; 50 percent of unregulated land treated as regulated, so that 25 percent of unregulated land meets aggressive performance standard; designation as necessary.
 - Construction: Erosion and sediment control on all lands subject to Construction General Permit.
 - CAFO production areas: Waste management, barnyard runoff control, mortality composting. Precision feed management for all animals. Same standards apply to AFOs not subject to CAFO permits except no feed management on dairies; designation as necessary.

- Additional reductions from agricultural nonpoint sources necessary to meet July 1 and August 13 nitrogen, phosphorus and sediment allocations that EPA will ensure occurs through additional federal backstop actions.
- Finer scale wasteload and load allocations (same level of detail as tidal states) to ensure NPDES permits will be consistent with Chesapeake Bay TMDL wasteload allocations.

The jurisdictions are encouraged to revise and strengthen their draft Phase I WIPs before final versions are due November 29 to meet the basin-state pollution allocations and provide reasonable assurance the allocations will be achieved. During this time, EPA will engage jurisdictions to share best approaches from the WIPs across the jurisdictions and provide EPA guidance on the most effective pollution controls. When final Phase I WIPs are submitted, EPA will again evaluate the plans to determine if EPA backstop allocations can be replaced with sufficiently improved state commitments.

In 2011, the jurisdictions are expected to submit Phase II WIPs that allocate the pollutant loads on a geographically smaller scale. Phase III WIPs in 2017 are expected to be designed to provide additional detail of restoration actions beyond 2017 and ensure that the 2025 goals are met.

Public Participation

The release of the draft Chesapeake Bay TMDL on September 24, 2010 began a 45-day public comment period that concludes on November 8, 2010. During the public comment period, there are 18 public meetings in all six watershed states and the District. A full public meeting schedule, including registration links for an online broadcast in each jurisdiction, is available at <http://www.epa.gov/chesapeakebaytmdl>. The website also provides a link for accessing and formally commenting on the draft TMDL.

The TMDL is available for viewing at EPA Region III, 1650 Arch Street, Philadelphia, PA 19103 with arrangements made in advance with the Region 3 library (215-814-5254 or library-reg3@epa.gov), EPA Chesapeake Bay Program Office at 410 Severn Avenue Suite 112, Annapolis, MD 21403 (Contact Debbie Embleton 410-267-9856 or Embleton.debbie@epa.gov) or EPA Docket Center, EPA/DC, EPA West, Room 3334, 1301 Constitution Ave., NW., Washington, DC (Docket Number EPA-R03-OW-2010-0736 and reading room phone number (202) 566-1744).

Options for comment are:

- Electronically, visit: www.regulations.gov. Docket ID No. EPA-R03-OW-2010-0736
- In writing, mail to: Water Docket, EPA, Mail code: 2822T, 1200 Pennsylvania Ave., NW., Washington, D.C., 20460.
- By hand, drop off from 8:30 a.m. - 4:30 p.m.: EPA Docket Center Public Reading Room, EPA Headquarters West, Room 3340, 1301 Constitution Ave., NW, Washington, D.C.

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Foreword

This document describes the technical, legal, and policy underpinnings of the Chesapeake Bay Total Maximum Daily Load (TMDL). While EPA Regions 2 and 3 are establishing this TMDL, it represents the product of decades of monitoring and model development, and years of focused dialogue and analysis among EPA, our state partners, and numerous stakeholders. This document has benefited from input of hundreds of professionals dedicated to the restoration of the Chesapeake Bay. In accordance with the Clean Water Act and Executive Order 13508 (signed by President Obama on May 12, 2009), the Bay TMDL provides a critical plan to restore and maintain the living resources of the Chesapeake Bay.

A TMDL is required by the Clean Water Act for waters that are on state lists identifying waters that are not attaining state adopted water quality standards. Most of the waters of the Bay and its tidal tributaries are on the states' lists of impaired waters because of excess nitrogen, phosphorus, and sediment. The Chesapeake Bay TMDL identifies the loadings of nitrogen, phosphorus, and sediment that are necessary to achieve the applicable state water quality standards for the Bay and its tidal tributaries for dissolved oxygen, chlorophyll 'a' (an indication of algae), water clarity, and submerged aquatic vegetation (SAV, or underwater Bay grasses). For this reason, the Chesapeake Bay TMDL has been described as a pollution diet of pollutant loadings necessary to attain water quality and restore the aquatic life resources of the Chesapeake Bay.

The Chesapeake Bay drains streams and rivers from many jurisdictions in the mid- Atlantic region of the United States including: Delaware, District of Columbia, Maryland, New York, Pennsylvania, Virginia, and West Virginia. Since these waters drain to the Chesapeake Bay and therefore contribute to the pollutant loadings to the Bay, the Chesapeake Bay TMDL will establish total maximum daily loads allowable for these waters and jurisdictions. These loadings are further divided to each of the 92 segments that comprise the waters of the Chesapeake Bay and its tidal tributaries. Thus, the Chesapeake Bay TMDL is actually an assemblage of 92 TMDLs, one for each segment, and also one for each pollutant including nitrogen, phosphorus and sediment.

The focus of the Chesapeake Bay TMDL is to identify the pollutant loadings needed to restore the Bay, and it thus allocates loading reductions to all source sectors in all parts of the Bay watershed. Because of the Bay-wide nature of these loading reductions, the water quality benefits from these reductions will not be limited to the Bay and its tidal tributaries. In fact, all waters from the point the reductions are made to the point that they enter the Bay should benefit from some measure of improved water quality. The controls necessary to reduce nutrients and sediment are also likely to reduce other pollutants.

While the Chesapeake Bay TMDL establishes the pollutant loadings for nitrogen, phosphorus, and sediment needed to restore and maintain a healthy Bay, the TMDL is an information and planning tool and does not by itself implement the needed controls. Other provisions of the Clean Water Act and state laws, regulations, and funding are needed to achieve these loading levels. The Bay TMDL will be implemented using an accountability framework that includes state Watershed Implementation Plans (WIPs), two-year milestones, EPA's tracking and assessment of restoration progress and, as necessary, specific federal actions if the Bay jurisdictions do not meet their commitments. The WIPs are the opportunity for each state to set up a system of controls and allocations to attain the respective loading cap for that state basin, which EPA will

consider in making its TMDL allocation decisions. The accountability framework is being established in part to provide demonstration of the reasonable assurance provisions of the Chesapeake Bay TMDL pursuant to both Section 117(g)(1) of the CWA and Executive Order 13508, but is not part of the Chesapeake Bay TMDL itself. The accountability framework is designed to help ensure that these nutrient goals and water quality requirements, as embodied in the Chesapeake Bay TMDL, are met.

An executive summary provides an overview of the TMDL, highlighting its more important aspects. For more specific information, readers should consult the main document which describes each aspect of the Chesapeake Bay TMDL in detail. Finally, for additional background and supportive material, the reader is referred to the numerous appendices and references contained in the main document.

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This document was developed through the collaborative efforts of the U.S. Environmental Protection Agency (EPA) and its seven Chesapeake Bay watershed partners—Delaware, District of Columbia, Maryland, New York, Pennsylvania, Virginia and West Virginia—principally through the Chesapeake Bay Program's (CBP's) Water Quality Goal Implementation Team (WQGIT) (formerly the Water Quality Steering Committee), its principal workgroups and the former Nutrient Subcommittee. The CBP's Principals' Staff Committee made decisions on behalf of the partnership and provided policy direction to the WQGIT. Advice, direction and independent peer review were provided by the CBP's Scientific and Technical Advisory Committee (STAC), the Local Government Advisory Committee (LGAC) and the Citizen's Advisory Committee (CAC). Comments and recommendations gathered through the November–December 2009 public meetings and webinars were instrumental in ensuring that the published allocations provide the most benefits to local streams and rivers and still achieve the jurisdictions' Chesapeake Bay water quality standards.

The document resulted from the collaborative expertise, input, and feedback of many individuals from the multitude of CBP partnering agencies and institutions, local governments, nongovernmental organizations, businesses, and many other involved stakeholders. Their individual and collective contributions are hereby acknowledged. Appendix A provides a detailed member listing of the various groups and committees who were instrumental in completing the Chesapeake Bay total maximum daily load or TMDL.

Special acknowledgment is made to past and present members the following CBP committees: WQGIT, Principals' Staff Committee, Management Board, STAC, LGAC, CAC, Agriculture Workgroup, Forestry Workgroup, Sediment Workgroup, Urban Stormwater Workgroup, Wastewater Treatment Workgroup, Watershed Technical Workgroup, TMDL Workgroup (formerly Reevaluation Technical Workgroup), and the former Nutrient Subcommittee.

Special acknowledgement is also made to the following individuals (in alphabetical order): Katherine Antos, EPA Region 3 CBP Office; Mike Barnes, Chesapeake Research Consortium/CBP Office; Rich Batiuk, EPA Region 3 CBP Office; Benita Best-Wong, EPA Office of Water; Carin Bisland, EPA Region 3 CBP Office; Chris Brosch, University of Maryland/CBP Office; Jon Capacasa, EPA Region 3 Water Protection Division; Peter Claggett, U.S. Geological Survey/CBP Office; Jeff Corbin, EPA Region 3 Office of Regional Administrator; Jim Curtin, EPA Headquarters, Office of General Counsel; Christopher Day, EPA Region 3 Office of Regional Counsel; Helene Drago, EPA Region 3 Water Protection Division; Mark Dubin, University of Maryland/CBP Office; Jim Edward, EPA Region 3 CBP Office; J. Charles Fox, EPA Headquarters Office of the Administrator; Shawn Garvin, EPA Regional Administrator; Kelly Gable, EPA Region 3 Office Regional Counsel; Aaron Gorka, Chesapeake Research Consortium/CBP Office; Mike Haire, EPA Office of Water; Suzanne Hall, EPA Region 3 Water Protection Division; Ruth Izraeli, EPA Region 2 Division of Environmental Planning and Protection; Jeni Keisman, University of Maryland/CBP Office; Victoria Kilbert, Chesapeake Research Consortium/CBP Office; Bob Koroncai, EPA Region 3 Water Protection Division; Lewis Linker, EPA Region 3 CBP Office; Felix Locicero, EPA Region 2 Division of Environmental Planning and Protection; Travis Loop, EPA Region 3 CBP Office; Larry Merrill, EPA Region 3 Water Protection Division; Linda Miller, EPA Region 3; Jenny Molloy, EPA Region 3 CBP Office/Water Protection Division; Sucharith Ravi, University of Maryland/CBP

Office; Jennifer Sincock, EPA Region 3 Water Protection Division; Gary Shenk, EPA Region 3 CBP Office; Kelly Shenk, EPA Region 3 CBP Office; Rachel Streusand, Chesapeake Research Consortium/CBP Office; Jeff Sweeney, University of Maryland/CBP Office; Nita Sylvester, EPA Region 3 CBP Office; Peter Tango, U.S. Geological Survey/CBP Office; Tom Wall, EPA Headquarters Office of Water; Ping Wang, University of Maryland/CBP Office; Jing Wu, University of Maryland/CBP Office; John Wolf, U.S. Geological Survey/CBP Office; Rob Wood, EPA Region 3 CBP Office; and Ning Zhou, Virginia Polytechnical and State University/EPA Region 3 CBP Office.

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Members of the CBP's Water Quality Goal Implementation Team gather in Lancaster, Pennsylvania, in April 2009 to discuss development of the Chesapeake Bay TMDL.

SECTION 1. INTRODUCTION

This document establishes total maximum daily loads (TMDLs) for nutrients (nitrogen and phosphorus) and sediment for the Chesapeake Bay and its tidal tributaries and embayments as required by section 303(d) of the Clean Water Act (CWA) and its implementing regulations at Title 40 of the *Code of Federal Regulations* (CFR) section 130.7. This TMDL represents the culmination of decades of collaboration among many partners and stakeholders and is the result of an analysis of water quality pollution and its solution on an unprecedented geographic, scientific, and political scale. While all TMDLs are unique, this TMDL is distinguished by the magnitude of the watershed it addresses and the wealth of data developed and analyses conducted over the course of the past decades that support its conclusions.

In an effort to keep the Bay TMDL document as clear and succinct as possible, discussion of the technical analyses and modeling that support the pollutant allocations are reasonably summary in nature with links provided to the more detailed technical support documentation. Because of the large size of the watershed and the many individual sources, load allocations (LAs) and wasteload allocations (WLAs) that are summarized in Section 9 are presented in greater detail in supporting appendices.

This document is organized into 11 sections as follows:

- Section 1: CWA and regulatory, statutory, and historical background of the Chesapeake Bay TMDL
- Section 2: Description of the Chesapeake Bay watershed, the Bay, and its impaired segments
- Section 3: The jurisdictions' Chesapeake Bay water quality standards (WQS)
- Section 4: The major sources of nutrients and sediment in the Bay, its watershed and its airshed
- Section 5: The modeling tools used to develop the WLAs and LAs
- Section 6: How the TMDL was developed, including the allocation methodology and related considerations
- Section 7: Discussion of reasonable assurance, Bay TMDL implementation, and the Bay TMDL accountability framework
- Section 8: The evaluation of jurisdictions' Watershed Implementation Plans (WIP) and decisions on backstop allocations
- Section 9: The individual TMDLs for the 92 Bay tidal segments
- Section 10: Adaptive management approach to Bay TMDL implementation
- Section 11: Documentation of public participation, comments, and responses

This document also contains three additional sections providing: a list of references (Section 12), a glossary (Section 13), and a list of abbreviations (Section 14).

Additional supporting information that is not part of this document, or its appendices, can be found as follows:

- Technical documentation for each of the Chesapeake Bay TMDL models—airshed, land change, Scenario Builder, SPARROW, watershed, Bay water quality/sediment transport, oyster filter feeder and menhaden filter feeder—are provided via URL in Section 5.
- Each of the jurisdictions' Phase I Watershed Implementation Plans (WIPs) is provided via URL in Section 7. The WIPs are part of the accountability framework meant to implement the Bay TMDL, but they are not part of the Bay TMDL itself. EPA also is reviewing the WIPs as part of the information to inform its allocation decisions.
- Publicly accessible agreements, documents, reports, papers, meeting summaries, and correspondence developed during the decades and more recent years leading up to the Chesapeake Bay TMDL, which were instrumental in setting the scientific, policy, and legal foundation on which the Bay TMDL is built, are provided via URL in Appendix B.

1.1. TMDLs and the CWA

Section 303(c) of the 1972 CWA requires states, including the District of Columbia, (collectively referred to as *jurisdictions*) to establish WQS that identify each waterbody's designated uses and the criteria needed to support those uses. The CWA establishes a *rebuttable presumption* that all waters can attain beneficial aquatic life uses, i.e., *fishable* and recreational uses, i.e., *swimmable*.

Section 303(d) of the CWA requires states, including the District of Columbia, (collectively referred to as *jurisdictions*) to develop lists of impaired waters that fail to meet WQS set by jurisdictions even after implementing technology-based and other pollution controls. EPA's regulations for implementing CWA section 303(d) are codified in the Water Quality Planning and Management Regulations at 40 CFR Part 130. The law requires that jurisdictions establish priority rankings and develop TMDLs for waters on the lists of impaired waters (40 CFR 130.7).

A TMDL specifies the maximum amount of a pollutant that a waterbody can receive and still meet applicable WQS. A mathematical definition of a TMDL is written as the sum of the individual WLAs for point sources, the LAs for nonpoint sources and natural background, and a margin of safety [CWA section 303(d)(1)(C)]:

$$\text{TMDL} = \Sigma WLA + \Sigma LA + MOS$$

where

WLA = wasteload allocation, or the portion of the TMDL allocated to existing and/or future point sources.

LA = load allocation, or the portion of the TMDL attributed to existing and/or future nonpoint sources and natural background.

MOS = margin of safety, or the portion of the TMDL that accounts for any lack of knowledge concerning the relationship between effluent limitations and water quality, such as uncertainty about the relationship between pollutant loads and

receiving water quality, which can be provided implicitly by applying conservative analytical assumptions or explicitly by reserving a portion of loading capacity.

The process of calculating and documenting a TMDL involves a number of tasks and—especially for a large, complex, multijurisdictional waterbody with multiple impairments—can require substantial effort and resources. Major tasks involved in the TMDL development process include the following:

- Characterizing the impaired waterbody and its watershed
- Identifying and inventorying the relevant pollutant source sectors
- Applying the appropriate WQS
- Calculating the loading capacity using appropriate modeling analyses to link pollutant loads to water quality
- Identifying the required source allocations

The Bay TMDL report presents the results of the numerous analyses and model simulations and documents the informational elements described above. Because the Chesapeake Bay watershed is so large, and the analysis required for developing the Bay TMDL so extensive, the Chesapeake Bay TMDL and its supporting documentation consists of this report and additional supporting materials in the numerous appendices referenced throughout the report. The Bay TMDL is also supported by an extensive list of significant documents (Appendix B).

1.2 History of the Chesapeake Bay TMDL

The Chesapeake Bay watershed has been inhabited for thousands of years, but the population started to increase significantly with the arrival of European settlers in the 1600s. Settlers began clearing forests for timber and to make room for expanding agricultural activities, increasing soil erosion and nutrient delivery to the Bay and its tributaries (Curtin et al. 2001; Rountree et al. 2007). As early as 1900, the oyster population began to decline. Throughout the 20th century, urban development and agricultural activities increased throughout the watershed. In the late 1970s, Maryland Senator Charles Mathias sponsored a congressionally funded, 5-year study to analyze the rapid loss of aquatic life that was affecting the Bay. That study identified excess nutrient pollution as the main source of the Bay's degradation (USEPA 1982, 1983a, 1983b, 1983c, 1983d).

1.2.1 Regulatory and Management Initiatives

In response to the Bay's decline, various regulatory and management initiatives have been undertaken aimed at Bay restoration, ranging from cooperative agreements among surrounding jurisdictions to regulatory and policy programs. Through the years, the agreements and alliances have become more formalized and inclusive to address the multitude of factors contributing to the deterioration in Chesapeake Bay water quality. The following paragraphs outline the major policy, legislative, and programmatic events that have led to the development of the Bay TMDL, including the management agreements and regulatory requirements that form the underpinning of the TMDL.

1983 Chesapeake Bay Agreement

In 1983 the governors of Maryland, Virginia, and Pennsylvania; the mayor of the District of Columbia; the chairman of the Chesapeake Bay Commission; and EPA's Administrator signed the first Chesapeake Bay Agreement. In that agreement, the signatories acknowledged the decline in living resources of the Chesapeake Bay and agreed to establish the Chesapeake Executive Council (CEC) to "assess and oversee the implementation of coordinated plans to improve and protect the water quality and living resources of the Chesapeake Bay estuarine systems" (Chesapeake Bay Partnership 1983).

1987 Chesapeake Bay Agreement

Faced with the need to take a more comprehensive and coordinated approach to restoring water quality and living resources of the Chesapeake Bay, the signatories to the 1983 agreement entered into the 1987 Chesapeake Bay Agreement (CEC 1987). The 1987 Chesapeake Bay Agreement set priority goals and commitments, of which a key goal was to "reduce and control point and nonpoint sources of pollution to attain the water quality condition necessary to support the living resources of the Bay." To achieve that goal, signatories to the 1987 Bay Agreement committed to reduce the controllable nitrogen and phosphorus loads delivered to the mainstem of the Chesapeake Bay by 40 percent by 2000 and to develop a Bay-wide implementation strategy to achieve those reductions (CEC 1987).

CWA Section 117 and the Chesapeake Bay Program (CBP)

In the 1987 amendments to the CWA, Congress—in section 117—authorized the formation and funding of the CBP within EPA Region 3. Congress directed the CBP to collect and disseminate information related to the environmental quality of the Bay, to "coordinate state and federal efforts to improve Bay water quality, to evaluate sediment impacts on the Bay, and to determine the impact of natural and human-induced environmental changes on the living resources of the Bay."

¹

1991 Reevaluation

A 1991 reevaluation of progress made toward the 1987 Bay Agreement's 40 percent nutrient reduction goal led to a detailed quantification of the original narrative goal. Each major river basin by jurisdiction received a "tributary nutrient load allocation" as a "40% controllable load reduction" for both nitrogen and phosphorus as the principal outcome of the reevaluation (Secretary Robert Perciasepe 1992). The 1991 reevaluation also introduced several concepts still applicable in the Bay TMDL: tributary strategies (WIPs), limit of technology (E3 scenario), recognition of air deposition (air allocation to tidal surface waters), and geographic-based allocations (relative effectiveness-based allocation methodology).

1992 Amendments to the Chesapeake Bay Agreement

The 1991 reevaluation led to several amendments to the 1987 Chesapeake Bay Agreement in 1992, including an increased focus on the importance of tributaries in the Bay's restoration. The parties to the 1987 Chesapeake Bay Agreement were to begin by 1993 to develop and implement tributary-specific strategies to meet mainstem nutrient reduction goals, to improve water quality, and to restore living resources to the mainstem and tributaries (CEC 1992). The amendments

¹ Clean Water Act section 117 (33 United States Code [U.S.C.] 1267).

also established the distribution of submerged aquatic vegetation (SAV) as an initial measure of progress toward the water quality and living resource goals of the 1987 Agreement.

1997 Reevaluation

In 1997 the CBP conducted a year-long evaluation to assess what progress had been made toward the goal set in the 1987 Agreement of a 40 percent reduction in nitrogen and phosphorus delivered to the Bay by 2000 (CEC 1997). The 1997 reevaluation found that between 1985 and 1996 phosphorus loads delivered to the Bay declined by 6 million pounds annually, and nitrogen loads delivered to the Bay declined by 29 million pounds annually. By 1996 phosphorus loads from wastewater dischargers had been reduced by 51 percent in the participating jurisdictions as a result of implementing effluent standards, upgrading wastewater treatment plants, and banning phosphate laundry detergents. Wastewater nitrogen loads were reduced by 15 percent by implementing biological nutrient removal at some major municipal wastewater treatment facilities and industrial wastewater treatment facility upgrades. Implementation of nutrient reduction best management practices (BMPs) reduced nonpoint source loadings of nitrogen and phosphorus to the Bay by 7 and 9 percent, respectively. There was no clear trend in Bay dissolved oxygen (DO) levels, however. Although progress was made, the 1997 reevaluation report stated, “we must accelerate our efforts to close the gap on the year 2000 goal, maintain those reduced loading levels into the future and if necessary adjust the nutrient goals to help us achieve the water quality improvements needed to sustain living resources in the Bay” (CBP 1997).

1999 Integration of Cooperative and Statutory Programs

In September 1999, senior water quality program managers representing the jurisdictions and EPA outlined the *Process for Integrating the Cooperative and Statutory Programs of the Chesapeake Bay and its Tributaries—Continuing the Watershed Partnership to Restore the Chesapeake Bay* (CBP 1999). That consensus document laid the groundwork for the water quality goals and commitments within the Chesapeake 2000 Agreement. A decade in advance, it set the partnership on a course that culminated in the Bay TMDL.

Chesapeake 2000 Agreement

In June 2000 the governors of Maryland, Virginia, and Pennsylvania; the mayor of the District of Columbia; the Administrator of EPA; and the chairman of the Chesapeake Bay Commission signed the Chesapeake 2000 Agreement (CEC 2000). To meet the goal of “achieving and maintaining the water quality necessary to support the aquatic living resources of the Bay and its tributaries and to protect human health,” the signatories committed to specific actions, including:

Continue to achieve and maintain the 40 percent nutrient reduction goal agreed to in 1987.

By 2010, correct nutrient- and sediment-related problems in the Chesapeake Bay and its tidal tributaries sufficiently to remove the Bay and the tidal portions of its tributaries from the list of impaired waters under the Clean Water Act. In order to achieve this:

1. By 2001, define the water quality conditions necessary to protect aquatic living resources and then assign load reductions for nitrogen and phosphorus to each major tributary;
2. Using a process parallel to that established for nutrients, determine the sediment load reductions necessary to achieve the water quality conditions that protect aquatic living resources, and assign load reductions for sediment to each major tributary by 2001;
3. By 2002, complete a public process to develop and begin implementation of revised Tributary Strategies to achieve and maintain the assigned loading goals;
4. By 2003, the jurisdictions with tidal waters will use their best efforts to adopt new or revised [WQS] consistent with the defined water quality conditions. Once adopted by the jurisdictions, the Environmental Protection Agency will work expeditiously to review the new or revised standards, which will then be used as the basis for removing the Bay and its tidal rivers from the list of impaired waters; and
5. By 2003, work with the Susquehanna River Basin Commission and others to adopt and begin implementing strategies that prevent the loss of the sediment retention capabilities of the lower Susquehanna River dams.

2000 Six-Jurisdiction Memorandum of Understanding

In the fall of 2000, EPA, Delaware, the District of Columbia, Maryland, New York, Pennsylvania, and Virginia signed a Memorandum of Understanding (MOU) (Chesapeake Bay Watershed Partners 2000), with West Virginia joining as a signatory in June 2002, agreeing to the following:

- Work cooperatively to achieve the nutrient and sediment reduction targets necessary to achieve the goals of a clean Chesapeake Bay by 2010, thereby allowing the Chesapeake Bay and its tidal tributaries to be removed from the list of impaired waters.
- Provide for an inclusive, open and comprehensive public participation process.
- Collaborate on the development and use of innovative measures such as effluent trading, cooperative implementation mechanisms, and expanded interstate agreements to achieve the necessary reductions.

The signatories also agreed to report annually on progress toward achieving the goals of the agreement.

2003 Nutrient and Sediment Cap Load Allocations

In 2003 EPA and its watershed partners established nutrient and sediment cap loads on the basis of the Bay water quality model projections of attainment of the then EPA-proposed DO water quality criteria under long-term average hydrologic conditions (Secretary Tayloe Murphy 2003).

Reaching those cap loads was expected to eliminate the summer anoxic conditions in the deep waters of the Bay and the excessive algal blooms throughout the Bay and tidal tributaries (USEPA 2003b).

EPA and its watershed jurisdiction partners allocated the nutrient cap loads among the major river basins. Those jurisdictions with the highest impact on Bay water quality were assigned the highest nutrient reductions, while jurisdictions without tidal waters received less stringent reductions because they would not realize a direct benefit from the improved water quality conditions in the Bay (USEPA 2003b). Sediment allocations were based on the phosphorus-equivalent allocations to each major river basin by jurisdiction (USEPA 2003b).

Although not original signatories of the Chesapeake 2000 Agreement, New York, Delaware, and West Virginia signed on as partners in implementing the cap loads; thus, all seven Bay jurisdictions were assigned allocations (Chesapeake Bay Watershed Partners 2000; USEPA 2003b). The final total basinwide cap loads agreed to by the jurisdictions were 175 million pounds for nitrogen and 12.8 million pounds of phosphorus delivered to the tidal waters of the Bay (USEPA 2003b). The basinwide upland sediment cap load was 4.15 million tons (USEPA 2003b).

2004–2006 Tributary Strategies

To implement the cap loads, the seven watershed jurisdictions developed what became known as the Chesapeake Bay Tributary Strategies (Table 1-1) (Secretary Tayloe Murphy 2003). The tributary strategies outlined river basin-specific implementation activities to reduce nitrogen, phosphorus, and sediment from point and nonpoint sources sufficient to remove the Chesapeake Bay and its tidal tributaries and embayments from the Bay jurisdictions' respective impaired waters lists. Many of the policies and procedures used in developing the Chesapeake Bay TMDL originated with the development of the 2003 nutrient and sediment cap loads and subsequent development of tributary strategies.

Table 1-1. URLs for accessing the seven Chesapeake Bay watershed jurisdictions' tributary strategies

Jurisdiction	Tributary strategy
Delaware	http://www.chesapeakebay.net/watershedimplementationplantools.aspx?menuitem=52044
District of Columbia	http://www.chesapeakebay.net/watershedimplementationplantools.aspx?menuitem=52044
Maryland	http://www.dnr.state.md.us/bay/tribstrat/implementation_plan.html
New York	http://www.dec.ny.gov/docs/water_pdf/cbaystratfinal.pdf
Pennsylvania	http://www.chesapeakebay.net/watershedimplementationplantools.aspx?menuitem=52044
Virginia	http://www.chesapeakebay.net/watershedimplementationplantools.aspx?menuitem=52044
West Virginia	http://www.wvca.us/bay/files/bay_documents/8_9657_WV_Potomac_Tributary_Strategy_FIN_AL_from_web.pdf

2004–2005 Jurisdiction Adoption of Chesapeake Bay Water Quality Standards

In continued efforts to coordinate activities to address nutrient and sediment-based pollution in the Bay, the tidal jurisdictions of Maryland, Virginia, Delaware, and the District of Columbia adopted into their respective WQS regulations the EPA-published Chesapeake Bay water quality criteria for DO, water clarity, SAV, and chlorophyll *a*, along with criteria attainment assessment

procedures and refined tidal water designated uses (for details, see Section 3) (USEPA 2003a, 2003c). EPA approved those WQS modifications pursuant to CWA section 303(c).

2007 Reevaluation

Secretary Tayloe Murphy's 2003 memorandum summarized the comprehensive set of agreements made by Bay watershed partners with regard to cap loads for nitrogen, phosphorus, and sediment; new Bay-wide and local SAV restoration goals; and a commitment to reevaluate the allocations in 2007. The initiation of that reevaluation at a workshop in September 2005 laid the institutional groundwork for the collaborative work on the Bay TMDL (Chesapeake Bay Reevaluation Steering Committee 2005).

EPA and the seven jurisdictions reevaluated the nutrient and sediment cap loads in 2007, in response to the four Bay jurisdictions revising their WQS regulations for the Chesapeake Bay and its tidal tributaries (Secretary Tayloe Murphy 2003). The 2007 reevaluation found that sufficient progress had not been made toward improving water quality in the Chesapeake Bay to a level that the mainstem Chesapeake Bay and its tidal tributaries were no longer impaired by nutrients and sediment (Chesapeake Bay Reevaluation Steering Committee 2005).

1.2.2 Partnership Commitment to Develop the Chesapeake Bay TMDL

Throughout the Bay TMDL development process, EPA has worked in close and open partnership with all seven watershed jurisdictions, sharing decision making with the jurisdictions via the CBP structure described in more detail in Section 1.3. While EPA is developing the Bay TMDL, the seven watershed jurisdictions have been essential partners in the initiative, providing critical input and participating in deliberations and key decisions affecting the development process. The seven Bay watershed jurisdictions and EPA have been building the foundation for the Chesapeake Bay TMDL since signing the Chesapeake 2000 Agreement, which laid out the steps necessary to put in place an appropriate framework for a future Bay TMDL, including consistent jurisdictional Chesapeake Bay WQS (CEC 2000).

From September 2005 to the present, the seven watershed jurisdictions have been actively involved in decision making related to developing the Bay TMDL through participation in the CBP's Principals' Staff Committee (PSC), Water Quality Goal Implementation Team (WQGIT), and other decision-making committees and technical workgroups (see Section 1.3.1). The full records of the meetings and conference calls of those groups are accessible via the Internet—see Appendix C.

At the October 1, 2007, meeting of the PSC, the seven watershed jurisdictions and EPA reached consensus² that EPA would establish the Bay TMDL on behalf of the jurisdictions with a target restoration date of 2025 (CBP PSC 2007). Table 1-2 summarizes that and the other Bay TMDL-relevant consensus agreements reached by the partners during that meeting.

² Consensus within the Principals' Staff Committee means that all parties present have either agreed on this as a course of action and/or that no party objected to it.

Table 1-2. Summary of Chesapeake Bay TMDL relevant actions agreed to by the CBP's Principals' Staff Committee during its October 1, 2007, meeting

- The Bay watershed TMDLs will be developed jointly between the six Bay watershed states, the District, and EPA and then established by EPA.
- The Water Quality Steering Committee (WQSC) will draft nutrient and sediment cap load allocations by tributary basin by jurisdiction, and the PSC will formally adopt these allocations.
- The watershed states and the District would have responsibility for further assigning loads —WLAs and LAs—to sources consistent with EPA regulations and guidance.
- These state/District suballocations (WLA/LA) would become part of the overall Bay watershed TMDLs report.
- The final publication would contain all the required documentation supporting the EPA Bay watershed TMDLs in a single, integrated publication with extensive appendices.
- EPA will provide the technical resources/analyses required to support development of the Bay watershed TMDLs through the CBP Office staff and EPA-funded contractor support.
- The Bay watershed TMDLs must be completed and established by EPA no later than May 1, 2011.
- The CBP partners will engage stakeholders and the public in a more extensive structured dialogue about the tributary strategy implementation challenges before us.
- The CBP partners will focus on getting the programs in place by 2010 that we believe are required to achieve our water quality goals.
- The CBP partnership's public announcement of initiation of work on the Bay watershed TMDLs will occur following the states' submission and EPA approval of the 2008 303(d) lists in the spring 2008 time frame.
- Eight principles will guide the reevaluation efforts by the WQSC and its workgroups (see Attachment A for more detailed version):
 - Shared urgency to restore the Bay;
 - Clear communication and common message;
 - Focus and accelerate implementation (do no harm);
 - Engage the public about the implementation challenge;
 - Legal obligations will be met;
 - Improving and applying the latest science;
 - Flexibility of the sub-allocations within the major basins; and
 - Keep healthy waters healthy.
- The WQSC will proceed forward with the responsibility for carrying out the necessary preparation work following these eight guiding principles.
- The state/EPA Reevaluation Technical Workgroup (RTWG) will be reconvened and operate under the direction of the WQSC.
- The RTWG was charged with responsibility for resolving the existing technical issues in light of the desire to accelerate implementation at all scales. The WQSC will convene a parallel Implementation Workgroup and charge this group with the responsibility for ensuring that the reevaluation and TMDL development process results in acceleration of ongoing tributary strategy implementation.

Source: CBP PSC 2007

1.2.3 President's Chesapeake Bay Executive Order

On May 12, 2009, President Barack Obama issued the Chesapeake Bay Protection and Restoration Executive Order 13508, which calls for the federal government to lead a renewed effort to restore and protect the Chesapeake Bay and its watershed. Critical among its directives were

- Establish a Federal Leadership Committee to oversee the development and coordination of reporting, data management and other activities by agencies involved in Bay restoration.

- Require involved agencies to prepare and submit reports with recommendations on a wide range of Bay issues (EPA-HQ-OW-2009-0761; FRL-8978-8).
- Require the Federal Leadership Committee to develop a Strategy for Protecting and Restoring the Chesapeake Bay by May 2010 (see <http://executiveorder.chesapeakebay.net/>).
- Require the Federal Leadership Committee to publish an annual Chesapeake Bay Action Plan describing how Federal funding proposed in the President's Budget will be used to protect and restore the Chesapeake Bay during the upcoming fiscal year.
- Require federal agencies to consult extensively with Bay jurisdictions in preparing their reports.

Pursuant to the Executive Order, on May 12, 2010, the Federal Leadership Committee—led by the EPA Administrator and secretaries from the Departments of Agriculture, Commerce, Defense, Homeland Security, Interior, Transportation and others—issued its coordinated strategy for restoring the Chesapeake Bay (FLCCB 2010). That strategy sets measurable goals for improving environmental conditions in the Bay for the following:

- Clean water
- Habitat
- Fish and wildlife
- Land and public access

Other supporting strategies address citizen stewardship, climate change, science, and implementation and accountability.

A key element of the approach for meeting water quality goals is the development of this TMDL for the Chesapeake Bay (FLCCB 2010).

Parallel to the issuance of the Executive Order, the jurisdictions and the federal government committed to implement all necessary measures for restoring water quality in the Bay by 2025 and to meet specific milestones every 2 years (FRL-8955-4; Clean Water Act Section 303(d): Preliminary Notice of Total Maximum Daily Load (TMDL) Development for the Chesapeake Bay). To that end, EPA is developing an accountability framework to guide the overall restoration effort and to link it to implementation of the Chesapeake Bay TMDL. The accountability framework, which is discussed in more detail in Section 8, includes four elements:

- Watershed Implementation Plans (WIPs)
- Two-year milestones to demonstrate restoration progress
- EPA's commitment to track and assess progress
- Federal actions if the watershed jurisdictions fail to develop sufficient WIPs, effectively implement their WIPs, or fulfill their 2-year milestones

1.3 Bay TMDL Process, Partner Coordination and Responsibilities

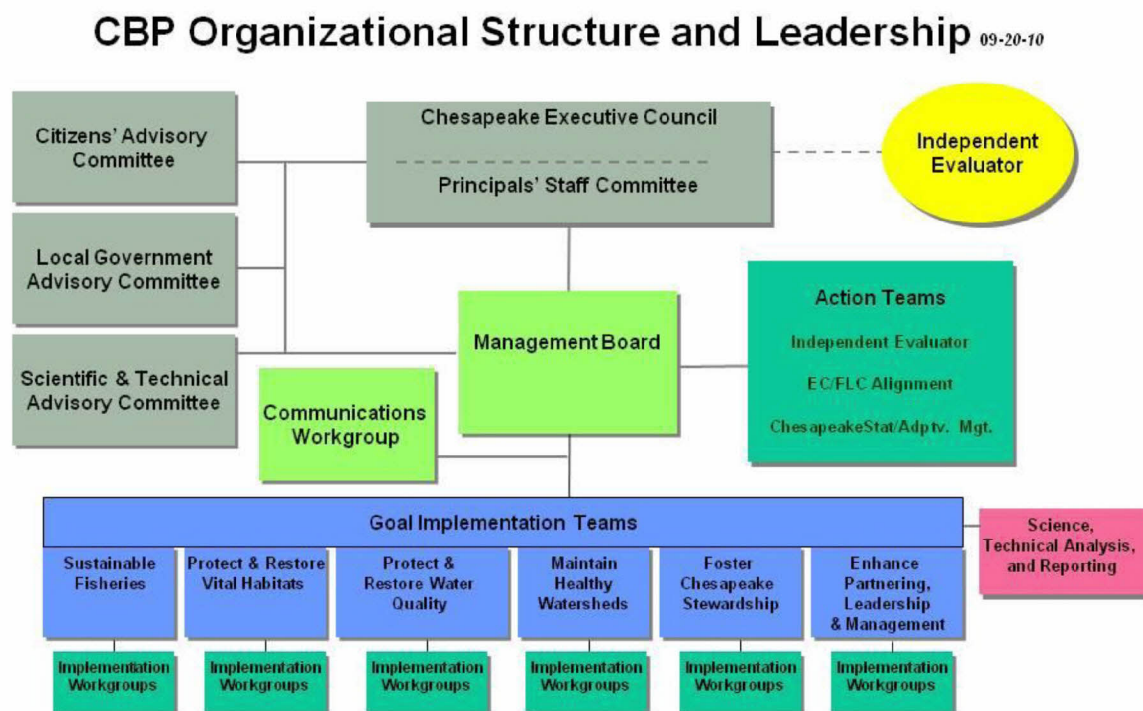
EPA Region 3 is the lead federal office responsible for developing the Chesapeake Bay TMDL, with the Water Protection Division (WPD) having direct responsibility for publication of the Bay TMDL. In developing this TMDL, WPD has coordinated efforts with the CBP Office, the Air

Protection Division, and the Office of Regional Counsel (all within Region 3), EPA Region 2, and EPA Headquarters. Throughout the Bay TMDL development process, EPA has worked in close and open partnership with all seven watershed jurisdictions, numerous federal agency partners, and a diverse array of other partners and stakeholders through the CBP partnership. This section describes the different elements of the CBP organizational structure and provides additional description of the roles and responsibilities of the various entities and stakeholders involved in developing the Chesapeake Bay TMDL.

1.3.1 CBP Partnership and Organizational Structure

The CBP is a unique regional partnership within EPA Region 3 that includes Maryland, Pennsylvania, Virginia, the District of Columbia, the Chesapeake Bay Commission, EPA, federal agencies, and participating advisory groups. The headwater states of Delaware, New York, and West Virginia participate as full partners on issues related to water quality. Each of the CBP partners agrees to use its own resources to implement projects and activities that advance Bay restoration.

The partnership defines its collective actions through formal, voluntary agreements and provides general policy direction through consensus documents, typically called directives. The CBP works through a series of Goal Implementation Teams with oversight provided by the CBP's Management Board. Extensive documentation of the CBP structure and governance is provided in *Chesapeake Bay Program Governance—Managing the Partnership for a Restored and Protected Watershed and Bay* (CBP 2009). Figure 1-1 shows the CBP organizational chart.



Source: CBP 2009

Figure 1-1. CBP's organizational structure.

Chesapeake Executive Council (CEC)

The top executive of each of the signatories of the Chesapeake 2000 Agreement (state governors, District of Columbia mayor, EPA Administrator, and Chesapeake Bay Commission Chair), form the CEC, which meets annually to set basinwide policies and the future directions for CBP. Delaware, New York, and West Virginia participate in CEC meetings and have full input status on all water quality-related matters. PSC members serve as advisors to their respective CEC members. The CEC has played a pivotal role in developing the Bay TMDL by signing the Chesapeake 2000 Agreement and subsequent directives and by setting the partnership on a well-defined, 10-year path directly supporting development of the Bay TMDL (CEC 2000, 2003, 2005).

Federal Leadership Committee

To bring the full weight of the federal government to address the Chesapeake's challenges, President Obama issued Executive Order 13508 on Chesapeake Bay Protection and Restoration and established the Federal Leadership Committee, which is chaired by the Administrator of the U.S. Environmental Protection Agency and includes senior representatives from the departments of Agriculture, Commerce, Defense, Homeland Security, Interior, and Transportation.

Principals' Staff Committee (PSC)

The PSC provided policy and programmatic direction to the Management Board and the WQGIT on the development and adoption of the Chesapeake Bay nutrient and sediment targets and allocations for the Bay TMDL (Figure 1-1). The PSC is composed of cabinet-level representatives from each of the seven watershed jurisdictions, EPA Region 3's Regional Administrator, senior federal agency executives, the Chesapeake Bay Commission executive director and the director of the CBP Office. The Regional Administrator of EPA Region 3 currently chairs the PSC. The Citizens, Local Governments, and the Scientific and Technical advisory committees all advise the PSC.

Management Board

PSC members provide policy and program direction to the Management Board which, in turn, provided strategic planning, priority setting, and operational guidance and direction to the WQGIT during the development of the Bay TMDL (Figure 1-1). The Management Board is composed of senior policy representatives from the seven watershed jurisdictions, the Chesapeake Bay Commission, the nine core federal agency partners,³ and the chairs of the Citizens, Local Governments, and the Scientific and Technical advisory committees. The Management Board directs and coordinates the efforts of the six Goal Implementation Teams and Action Teams. The director of the CBP Office chairs the Management Board, and the CBP Office provides for the staff to support the work of all the Goal Implementation Teams and workgroups. Staffing for the three advisory committees is supported by EPA through cooperative agreements with nonprofit organizations.

Water Quality Goal Implementation Team

The WQGIT's purpose is to support efforts to reduce and cap the nutrient and sediment loads entering the Bay and to ensure that such reductions are maintained over time. It is composed of

³ The Natural Resources Conservation Service, U.S. Forest Service, National Oceanic and Atmospheric Administration, U.S. Geological Survey, National Park Service, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Department of Defense, and EPA.

the members of the former Water Quality Steering Committee and the Nutrient Subcommittee. The WQGIT provided advice and guidance to EPA related to the targets and allocations before they were brought to the PSC. The WQGIT consists of senior water program managers from each of the seven Bay watershed jurisdictions, EPA Headquarters and Regions 2 and 3, the Chesapeake Bay Commission, the Susquehanna River Basin Commission, and the Potomac River Basin Commission. The WQGIT provided technical direction to the Watershed Technical, Agriculture, Forestry, Wastewater Treatment, Sediment, and Urban Stormwater workgroups.

Watershed Technical Workgroup

The Watershed Technical Workgroup was created to provide a forum for communication among the jurisdictions and other CBP participants on technical issues related to tributary strategy development, tracking and reporting. Members of the Watershed Technical Workgroup include technical staff and mid-level managers from the seven watershed jurisdictions, EPA, and point source and environmental stakeholder groups. For the Chesapeake Bay TMDL, the workgroup provided review and oversight in regards to application of the Bay Watershed Model.

Pollutant Source Workgroups

The Agricultural Workgroup coordinated and evaluated agricultural nutrient and sediment reduction measures throughout the jurisdictions and resolved issues related to tracking, reporting, and crediting conservation practices.

The Forestry Workgroup provided information on the effectiveness of different riparian forest buffer restoration and other forest management practices.

The Wastewater Treatment Workgroup provided a formal means of communication among federal agencies, state agencies/jurisdictions, and wastewater treatment plants.

The Sediment Workgroup provided technical and policy-related assistance to the CBP partners in setting the sediment allocations.

The Urban Stormwater Workgroup provided input related to all aspects of stormwater nutrient and sediment loads and management practices.

Science, Technical Analysis, and Reporting Team—Criteria Assessment Protocols Workgroup

The Criteria Assessment Protocols Workgroup had the lead responsibility for ensuring coordinated assessment of all Chesapeake Bay and tidal tributary/embayment waters related to the Bay jurisdictions' listing and delisting under CWA section 303(d). The workgroup also had the lead in developing, reviewing, and recommending to the WQGIT amendments to the original 2003 Chesapeake Bay water quality criteria.

Science, Technical Analysis, and Reporting Team—Modeling Workgroup

The Modeling Workgroup, formerly the Modeling Subcommittee and now under the Science, Technical Analysis, and Reporting (STAR) team, oversaw the development, calibration, verification, and management application of the suite of computer-based Bay models that supported the development of the Bay TMDL. The models allowed managers to estimate the pollutant load reductions needed to achieve WQS and to assess the potential of different management scenarios to achieve the needed pollutant load reductions.

Scientific and Technical Advisory Committee

The Scientific and Technical Advisory Committee (STAC) is composed of scientists from academic institutions from all seven watershed jurisdiction and federal science agencies, representing a diverse range of disciplines. STAC provides scientific and technical guidance and peer review to the CBP partnership on measures to restore and protect the Chesapeake Bay. STAC activities related to the Bay TMDL included providing for independent scientific peer reviews of all the Bay models (watershed, land change, estuarine water quality, estuarine sediment transport), Bay criteria assessment procedures, land use data, and reviewing and commenting on the draft Bay TMDL.

Local Governments Advisory Committee

The Local Governments Advisory Committee (LGAC) is a body of officials appointed by the governors of Maryland, Pennsylvania, Virginia, and the mayor of the District of Columbia to improve the role local governments can play in Bay restoration efforts and develop strategies to broaden local government participation in the CBP. The LGAC was directly involved in developing the Bay TMDL in the following ways: ensured the direct involvement of local elected officials in the decision-making processes, helped establish the local WIP pilots in 2010 (before development of the Phase II WIPs in 2011), and helped inform the thousands of local governments across the watershed about the Bay TMDL.

Citizen's Advisory Committee

The Citizens Advisory Committee (CAC) provided advice to the CEC, the PSC, the Management Board, and all the Goal Implementation Teams as needed in implementing the Chesapeake Bay Agreement. The CAC directly assisted the Bay TMDL development process by providing detailed recommendations on how to engage the nongovernmental components of the larger Bay watershed community and placing a strong focus on ensuring full accountability during the development and throughout the long-term implementation of the Bay TMDL.

Appendix A provides the membership lists of all the above described committees, teams, and workgroups at the time of publication of the Bay TMDL, fully acknowledging their individual and collective contributions.

1.4 Legal Framework for the Chesapeake Bay TMDL

1.4.1. What is a TMDL?

As discussed more fully in Section 1.1, a TMDL specifies the maximum amount of a pollutant that a waterbody can receive and still meet applicable WQS. Allocations to point sources are called WLAs, while allocations to nonpoint sources are called LAs. A TMDL is the sum of the individual WLAs (for point sources), LAs (for nonpoint sources and natural background) (40 CFR 130.2), and a margin of safety [CWA section 303(d)(1)(C)]. Section 303(d) requires that TMDLs be established for impaired waterbodies “at a level necessary to implement the applicable [WQS].”⁴

TMDLs are “primarily informational tools” that “serve as a link in an implementation chain that includes federally regulated point source controls, state or local plans for point and nonpoint

⁴ 33 U.S.C. 1313(d)(1)(C).

source pollutant reduction, and assessment of the impact of such measures on water quality, all to the end of attaining water quality goals for the nation's waters.”⁵ Recognizing a TMDL's role as a vital link in the implementation chain, federal regulations require that effluent limits in NPDES permits be “consistent with the assumptions and requirements of any available WLA” in an approved TMDL.⁶

In addition, before EPA establishes or approves a TMDL that allocates pollutant loads to both point and nonpoint sources, it determines whether there is *reasonable assurance* that the nonpoint source LAs will, in fact, be achieved and WQS will be attained (USEPA 1991a). If the reductions embodied in LAs are not fully achieved, the collective reductions from point and nonpoint sources will not result in attainment of the WQS.

The Bay TMDL will be implemented using an accountability framework that includes WIPs, 2-year milestones, EPA's tracking and assessment of restoration progress and, as necessary, specific federal actions if the Bay jurisdictions do not meet their commitments. The accountability framework is being established, in part, to demonstrate that the TMDL is supported by reasonable assurance. The accountability framework is also being established pursuant to CWA section 117(g)(1). Section 117(g) of the CWA directs the EPA Administrator to “ensure that management plans are developed and implementation is begun...to achieve and maintain...the nutrient goals of the Chesapeake Bay Agreement for the quantity of nitrogen and phosphorus entering the Chesapeake Bay and its watershed, [and] the water quality requirements necessary to restore living resources in the Chesapeake Bay ecosystem.”⁷ In addition, Executive Order 13508 directs EPA and other federal agencies to build a new accountability framework that guides local, state, and federal water quality restoration efforts. The accountability framework is designed to help ensure that the Bay's nutrient goals, as embodied in the Chesapeake Bay TMDL, are met. While the accountability framework informs the TMDL section 303(d) does not require that EPA “approve” the framework *per se*, or the jurisdictions' WIPs that constitute part of that framework.

1.4.2. Why is EPA establishing this TMDL?

In 1998 data showed the mainstem and tidal waters of the Chesapeake Bay to be impaired for aquatic life resources. EPA determined that the mainstem and tidal waters of the Chesapeake Bay must be placed on Virginia's section 303(d) list. EPA therefore added the mainstem of the Chesapeake Bay to Virginia's final section 303(d) list. As described in Section 2, each river, tributary, and other waterbody that is part of the Chesapeake Bay TMDL is included on a jurisdiction's section 303(d) list.

EPA is establishing the Chesapeake Bay TMDL pursuant to a number of existing authorities, including the CWA and its implementing regulations, judicial consent decrees requiring EPA to address certain impaired Chesapeake Bay and tidal tributary waters, a settlement agreement resolving litigation brought by the Chesapeake Bay Foundation, the current Chesapeake Bay Agreement, and Executive Order 13508. In establishing the Bay TMDL, EPA has acted pursuant

⁵ *Pronsolino v. Nastri*, 291 F.3d 1123, 1129 (9th Cir. 2002).

⁶ 40 CFR 122.44(d)(1)(vii)(B).

⁷ Clean Water Act section 117(g)(1)(A)-(B), 33 U.S.C. 1267(g)(1)(A)-(B).

to the consensus direction of the Chesapeake Executive Council's PSC and in partnership with each of the seven Chesapeake Bay watershed jurisdictions.

The CWA provides EPA with ample authority to establish the Chesapeake Bay TMDL. CWA section 117(g)(1) provides that "[t]he Administrator, in coordination with other members of the [CEC], shall ensure that management plans are developed and implementation is begun by signatories to the Chesapeake Bay Agreement to achieve and maintain [among other things] the nutrient goals of the Chesapeake Bay Agreement for the quantity of nitrogen and phosphorus entering the Chesapeake Bay and its watershed [and] the water quality requirements necessary to restore living resources in the Chesapeake Bay ecosystem." Because it establishes the Bay and tidal tributaries' nutrient and sediment loading and allocation targets, the Chesapeake Bay TMDL is such a *management plan*. In addition, the Bay TMDL's loading and allocation targets both inform and are informed by, a larger set of federal and state management plans being developed for the Bay, including the jurisdiction WIPs and the May 2010 Bay strategy.

CWA section 303(d) requires jurisdictions to establish and submit TMDLs to EPA for review. Under certain circumstances, EPA also has the authority to establish TMDLs. The circumstances of this TMDL do not necessarily identify the outer bounds of EPA's authority. However, where impaired waters have been identified on jurisdictions' section 303(d) lists for many years, where the states in question have decided not to establish their own TMDLs for those waters, where EPA is establishing a TMDL for those waters at the direction of, and in cooperation with, the jurisdictions in question, and where those waters are part of an interrelated and interstate water system like the Chesapeake Bay that is impaired by pollutant loadings from sources in seven different jurisdictions, CWA section 303(d) authorizes EPA authority to establish that TMDL⁸.

On May 12, 2009, President Barack Obama signed Executive Order 13508—*Chesapeake Bay Protection and Restoration*. The Executive Order's overarching goal is "to protect and restore the health, heritage, natural resources, and social and economic value of the Nation's largest estuarine ecosystem and the natural sustainability of its watershed." The Executive Order says the federal government "should lead this effort" and acknowledges that progress in restoring the Bay "will depend on the support of state and local governments." To that end, the Executive Order directs the lead federal agencies, including EPA, to work in close collaboration with their state partners. To protect and restore the Chesapeake Bay and its tidal tributaries, the President directed EPA to "make full use of its authorities under the [CWA]." In establishing the Bay TMDL, EPA is doing no more—or less—than making *full use* of its CWA authorities to lead a collaborative and effective federal and state effort to meet the Bay's nutrient and sediment goals.

A number of consent decrees, MOUs, and settlement agreements provide additional support for EPA's decision to establish the Chesapeake Bay TMDL addressing certain waters identified as impaired on the Maryland, Virginia, and District of Columbia's 1998 section 303(d) lists and on the Delaware 1996 section 303(d) list. EPA is establishing the Chesapeake Bay TMDL consistent with those consent decrees, MOUs, and settlement agreements, described below.

⁸ *Dioxin/Organochlorine Center v. Clarke*, 57 F.3d 1517 (9th Cir. 1995); *Scott v. City of Hammond*, 741 F.2d 992 (7th Cir. 1984); *American Canoe Ass'n. v EPA*, 54 F.Supp.2d 621 (E.D.Va. 1999).

Virginia–EPA Consent Decree

The American Canoe Association, Inc., and the American Littoral Society filed a complaint against EPA for failing to comply with the CWA, including section 303(d), regarding the TMDL program in the Commonwealth of Virginia. A consent decree signed in 1999 resolved the litigation.⁹ The consent decree includes a 12-year schedule for developing TMDLs for impaired segments identified on Virginia's 1998 section 303(d) list. The consent decree requires EPA to establish TMDLs for those waters, by May 1, 2011, if Virginia fails to do so according to the established schedule. Virginia has requested that EPA establish TMDLs for the nutrient- and sediment-impaired tidal portions of the Chesapeake Bay and its tributaries in accordance with the Virginia consent decree schedule (CBP PSC 2007). Table 1-1 provides a list of the Virginia consent decree waters that will be addressed by the Chesapeake Bay TMDLs for nutrients and sediment.

⁹ *American Canoe Association v. EPA*, 98cv979 (June 11, 1999).

Table 1-3. Virginia consent decree (CD) waters impaired for dissolved oxygen (DO) and/or nutrients that will be addressed by the Chesapeake Bay TMDL

Waterbody Name	CD Segment ID	Chesapeake Bay Segment ID	CD Impairment
Bailey Bay, Bailey Creek – Tidal	VAP-G03E	JMSTF1	DO
Broad Creek	VAT-G15E	ELIPH, WBEMH, SBEMH, EBEMH	DO
Chesapeake Bay Mainstem	Narrative ^a	CB5MH, CB6PH, CB7PH	Nutrients
Chesapeake Bay Mainstem	VACB-R01E	CB5MH, CB6PH, CB7PH	DO
Elizabeth River – Tidal	Narrative ^b	ELIPH, WBEMH, SBEMH, EBEMH	Nutrients
Hungars Creek	VAT-C14R	CB7PH	DO
James River – Tidal	Narrative ^c	JMSTF2, JMSTF1, JMSOH, JMSMH, JMSPH	Nutrients
King Creek	VAT-F27E	YRKPH	DO
Mattaponi River – Tidal	Narrative ^d	MPNTE, MPNOH	Nutrients
Messongo Creek	VAT-C10E	POCMH	DO
North Branch Onancock Creek	VAT-C11E	CB7PH	DO
Pagan River	VAT-G11E	JMSMH	DO
Pamunkey River – Tidal	Narrative ^e	PMKTF, PMKOH	Nutrients
Queen Creek	VAT-F26E	YRKMH	DO
Rappahannock River	Narrative ^f	RPPMH	Nutrients
Rappahannock River	VAP-E25E	RPPMH	Nutrients
Rappahannock River	VAP-E25E	RPPMH	DO
Rappahannock River	VAP-E26E	RPPMH	Nutrients
Rappahannock River	VAP-E26E	RPPMH	DO
Thalia Creek	VAT-C08E	LYNPH	DO
Williams Creek	VAN-A30E	POTMH	DO
York River	Narrative ^g	YRKMH, YRKPH	Nutrients
York River	VAT-F27E	YRKPH	DO

Source: *American Canoe Association v. EPA*, 98cv979 (June 11, 1999).

Notes:

a = Chesapeake Bay Mainstem (VACB-R01E) impaired for nutrients

b = Elizabeth River (VAT-G15E) impaired for DO, nutrients

c = James River (VAP-G01E, VAP-G03E, VAP-G02E, VAP-G04E, VAP-G11E, and VAP-G15E) impaired for nutrients

d = Mattaponi River (VAP-F24E and VAP-F25E) impaired for nutrients

e = Pamunkey River (VAP-F13E and VAP-F14E) impaired for DO, nutrients

f = Rappahannock River (VAP-E24E) impaired for DO

g = York River (VAT-F26E) impaired for nutrients

District of Columbia–EPA Consent Decree

In 1998 Kingman Park Civic Association and others filed a similar suit against EPA.¹⁰ The lawsuit was settled through the entry of a consent decree requiring EPA to, among other things, establish TMDLs for the District of Columbia's portions of the tidal Potomac and tidal Anacostia rivers if not established by the District of Columbia by a certain date.

¹⁰ *Kingman Park Civic Association v EPA*, 98cv00758 (June 13, 2000).

The impairment of the District of Columbia's portion of the upper tidal Potomac River by low pH is directly related to the Chesapeake Bay water quality impairments because the low pH is a result of excess nutrients causing algal blooms in the tidal river. Establishing a tidal Potomac River pH TMDL is directly linked to establishing the Chesapeake Bay TMDL because of their common impairing pollutants (nutrients) and the hydrologic connection between the District's portion of the tidal Potomac River and the Chesapeake Bay. EPA and the Kingman Park plaintiffs jointly sought, and received on February 12, 2008, a formal extension of the District of Columbia TMDL Consent Decree so that EPA could complete the Potomac River pH TMDL on the same schedule as the Chesapeake Bay TMDL. The District of Columbia requested that EPA establish the pH TMDL for the District's portion of the tidal Potomac River (CBP PSC 2007). Table 1-4 provides a list of the District's consent decree waters that will be addressed by the Chesapeake Bay TMDLs for nutrients and sediment.

In addition, Anacostia Riverkeeper and Friends of the Earth filed suit against EPA challenging more than 300 TMDLs for the District of Columbia, including the Anacostia River TMDLs, because the TMDLs did not contain daily loads. On May 25, 2010, the District Court for the District of Columbia ordered the vacatur of the District of Columbia's TMDL for pH for the Washington Ship Channel, with a stay of vacatur until May 31, 2011. With the Bay TMDL, the Washington Ship Channel pH impairment will be addressed and will supersede the pH TMDL for the Ship Channel approved by EPA on December 15, 2004.

Table 1-4. District of Columbia consent decree (CD) waters impaired for pH that will be addressed by the Chesapeake Bay TMDL

Waterbody Name	CD Segment ID	Chesapeake Bay Segment ID	CD Impairment
Washington Ship Channel	DCPWC04E_00	POTTF_DC	pH
Middle Potomac River	DCPMS00E	POTTF_DC	pH

Source: *Kingman Park Civic Association v EPA*, 98cv00758 (June 13, 2000).

Delaware–EPA Consent Decree

In 1996 the American Littoral Society and the Sierra Club filed a suit against EPA to ensure that TMDLs were developed for waters on Delaware's 1996 section 303(d) list, one of which is a tidal Bay segment (Upper Nanticoke). The parties entered into a consent decree resolving the lawsuit.¹¹ The consent decree required EPA to establish TMDLs if Delaware failed to do so within the 10-year TMDL development schedule. Although Delaware established TMDLs for the one listed tidal Bay segment (DE DNREC 1998), the TMDLs were established to meet prior WQS and are insufficient to attain Chesapeake Bay WQS.

Maryland–EPA MOU

In 1998 Maryland and EPA Region 3 entered into an MOU that, among other things, established a 10-year schedule for addressing waters on Maryland's 1998 section 303(d) list, with completion by 2008 (MDE 1998). Because of funding constraints, the complexity of some TMDLs, and limited staff resources, Maryland determined that it would not be able to address all 1998 listed waters by 2008. Further, the Chesapeake 2000 Agreement established a goal of meeting water quality goals in the Chesapeake Bay by 2010 (CEC 2000). Many of the waters on

¹¹ *American Littoral Society, et al. v EPA, et al.*, 96cv591 (D.Del. 1997).

Maryland's 1998 section 303(d) list were open waters of the Bay or tidal tributaries to the Bay. Maryland determined that developing TMDLs for those tidal waters before the deadline established by the MOU, as would be required under the schedule established in 1998, "would undermine the spirit of the agreement" because of a lack of integration between the CBP and Maryland efforts (MDE 2004). Therefore, Maryland decided to postpone development of TMDLs for Maryland's listed Chesapeake Bay and tidal tributary waters until the two programs could coordinate efforts.

In September 2004, Maryland and EPA Region 3 entered into a revised MOU that extended the schedule for TMDL development to 13 years (by 2011) (MDE 2004). Although neither Maryland nor EPA is under a consent decree for establishing TMDLs for Maryland waters, the state has requested that EPA develop the TMDLs for the Maryland portion of the Chesapeake Bay and tidal tributaries impaired by excess nutrients and sediment as recognized in the MOU between Maryland and EPA (CBP PSC 2007).

Chesapeake Bay Foundation Settlement Agreement

In January 2009, the Chesapeake Bay Foundation and others filed suit against EPA in U.S. District Court for the District of Columbia (1:09-cv-00005-CKK) alleging, among other things, that EPA had failed to carry out nondiscretionary duties under CWA section 117(g) designed to restore and preserve the Chesapeake Bay. In May 2010, EPA signed a settlement agreement with the plaintiffs promising to take a number of actions to restore and preserve the Bay. In particular, EPA promised that by December 31, 2010, it would establish a TMDL for those segments of the Chesapeake Bay impaired by nitrogen, phosphorus, and sediment. EPA is establishing this TMDL, in part, to meet that commitment.

SECTION 2. WATERSHED AND IMPAIRMENT DESCRIPTION

This section provides a general description of the watershed and the impairments addressed in the Chesapeake Bay TMDL. Section 2.1 provides a description of the basic history, geography, land uses, and recent development patterns and trends. Section 2.2 presents the scope of the TMDL including the parameters of concern, the specific impairment listings addressed, and the TMDL segmentation.

2.1 General Watershed Setting

The Chesapeake Bay watershed includes parts of six states—Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia—and the entire District of Columbia (collectively, the jurisdictions). The Chesapeake Bay proper is approximately 200 miles long, stretching from Havre de Grace, Maryland, to Norfolk, Virginia. It varies in width from about 3.4 miles near Aberdeen, Maryland, to 35 miles near the mouth of the Potomac River. The easternmost boundary of the Chesapeake Bay with the Atlantic Ocean is represented by a line between Cape Charles and Cape Henry. Including its tidal tributaries, the Chesapeake Bay encompasses approximately 11,684 miles of shoreline.

About half of the Bay's water volume consists of saltwater from the Atlantic Ocean. The other half is freshwater that drains into the Bay from its 64,000-square-mile watershed (Figure 2-1). Ninety percent of the freshwater is delivered from five major rivers: the Susquehanna (which is responsible for about 50 percent), Potomac, James, Rappahannock, and York rivers. In all, the watershed contains more than 100,000 streams and rivers that eventually flow into the Bay.

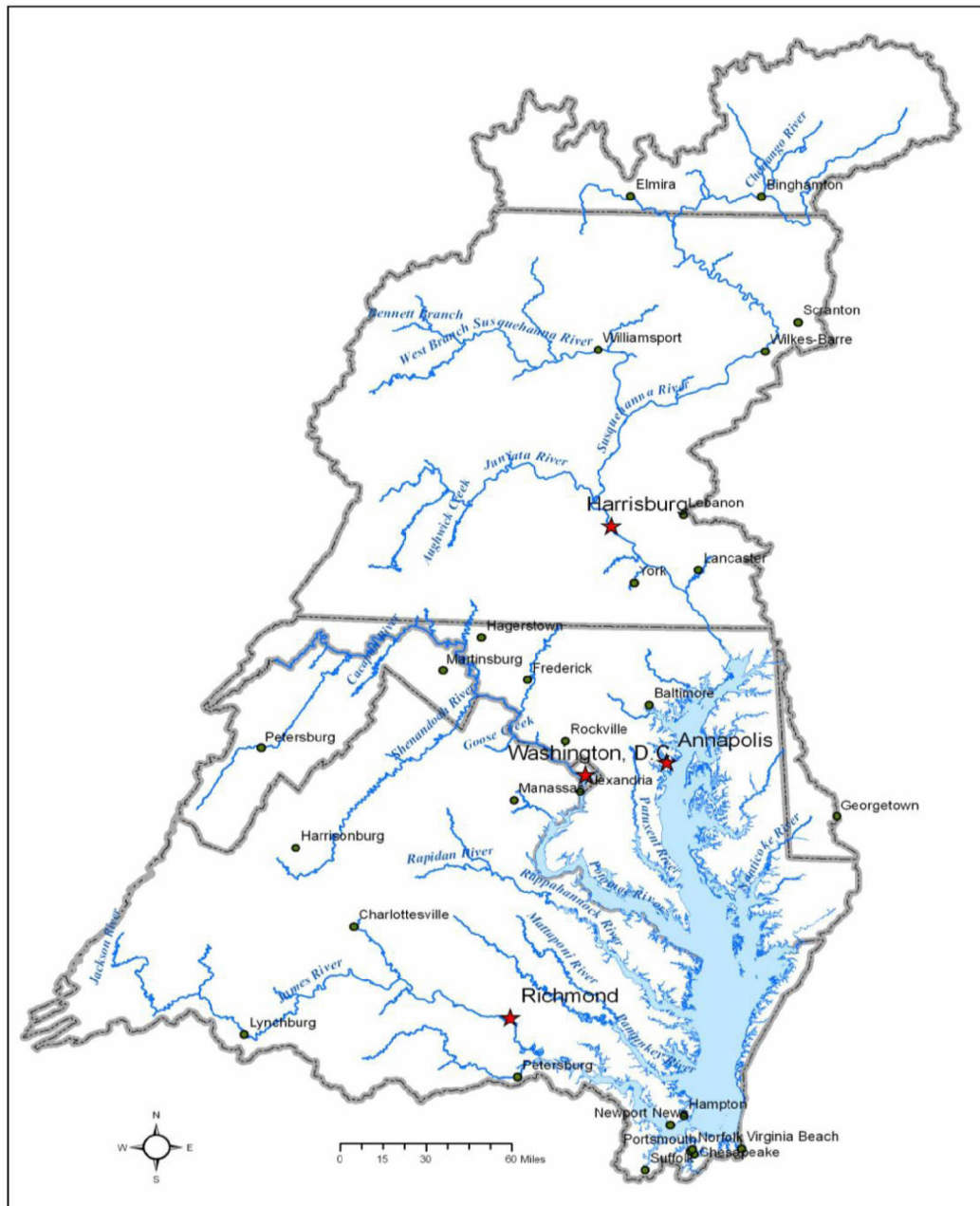


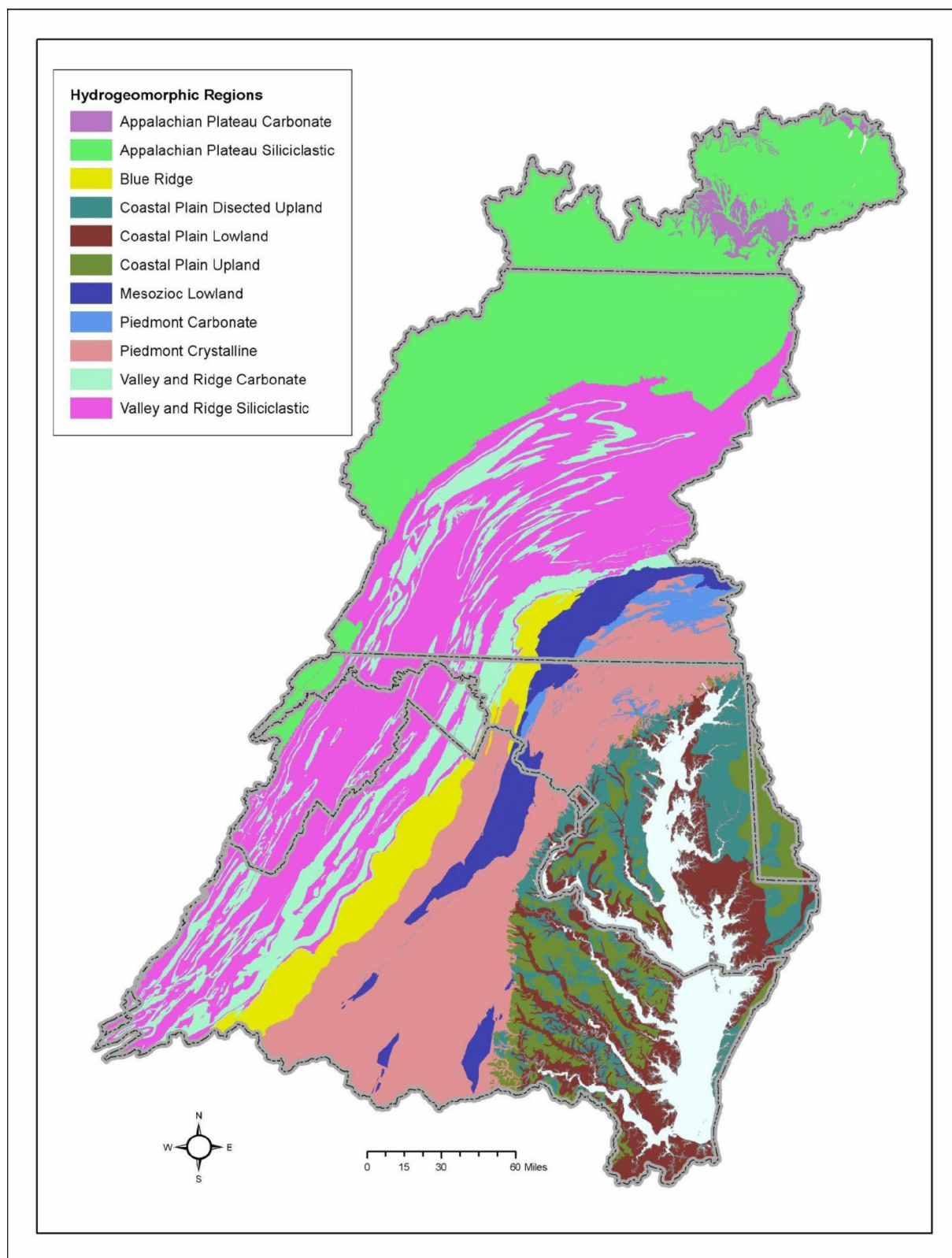
Figure 2-1. The Chesapeake Bay watershed with major rivers and cities.

Runoff from the Bay's enormous watershed flows into an estuary with a surface area of 4,500 square miles resulting in a land-to-water ratio of 14 to 1. That large ratio is one of the key factors in explaining why the drainage area has such a significant influence on water quality in the Bay.

Although the Chesapeake Bay is entirely within the Atlantic Coastal Plain, its watershed includes parts of the Piedmont and Appalachian provinces. The waters that flow into the Bay have different chemical identities, depending on the geology from which they originate (Figure 2-2).

The Atlantic Coastal Plain is a flat, lowland area with a maximum elevation of about 300 feet. It is supported by a bed of crystalline rock, covered with southeasterly dipping wedge-shaped layers of relatively unconsolidated sand, clay, and gravel. Water passing through the loosely compacted mixture dissolves many of the minerals. The most soluble elements are iron, calcium, and magnesium. The coastal plain extends from the edge of the continental shelf, to the east, to a fall line that ranges from 15 to 90 miles west of the Chesapeake Bay. The fall line, which is the location where free flowing streams enter tidal waters, forms the boundary between the Piedmont Plateau and the coastal plain. Waterfalls and rapids clearly mark this line, which is close to Interstate 95. At the fall line, the elevation rises to 1,100 feet.

The Piedmont Plateau extends from the fall line in the east to the Appalachian Mountains in the west. The area is divided into two geologically distinct regions by Parrs Ridge, which traverses Carroll, Howard, and Montgomery counties in Maryland and adjacent counties in Pennsylvania. Several types of dense, crystalline rock—including slates, schists, marble, and granite—compose the eastern side of the Piedmont Plateau. That variety results in a very diverse topography. Rocks of the Piedmont tend to be impermeable, and water from the eastern side is low in calcium and magnesium salts. The western side of the Piedmont consists of sandstones, shales, and siltstones, layered over by limestone. The limestone bedrock contributes calcium and magnesium to its water, making it hard. Waters from the western side of Parrs Ridge flow into the Potomac River, one of the Chesapeake Bay's largest tributaries.



Source: USGS WRIR 00-424

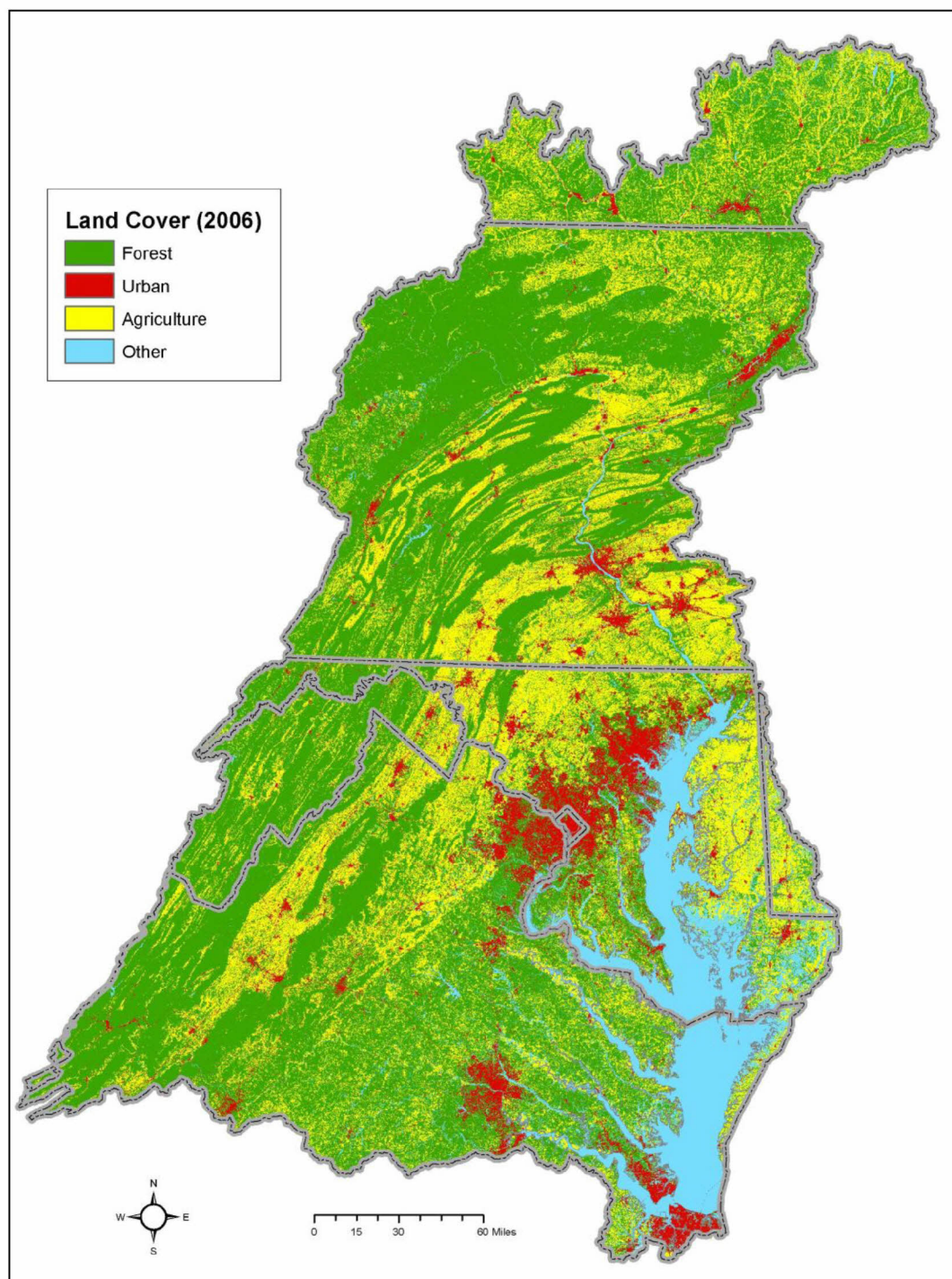
Figure 2-2. Hydrogeomorphic regions of the Chesapeake Bay watershed.

The Appalachian Province covers the western and northern part of the watershed and is rich in coal and natural gas deposits. Sandstone, siltstone, shale, and limestone form the bedrock. Water from that province flows to the Chesapeake Bay mainly via the Susquehanna River.

Earliest evidence of human inhabitants in the Bay watershed is of hunter-gatherers as long as 10,000 years ago, while Native Americans began cultivating crops and settling in villages throughout the area around 1,000 years ago. European settlement less than 500 hundred years ago began a period of transformation of forests into farmland, while today many of those lands are undergoing retransformations into urban and suburban lands.

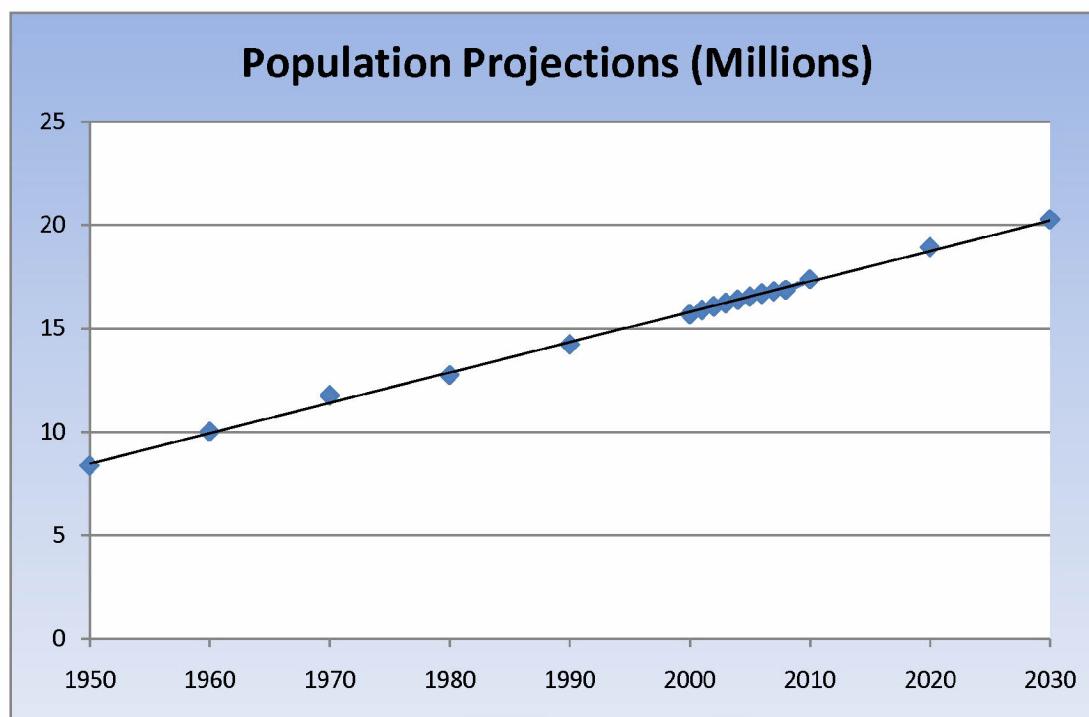
Over the past hundreds of years, forest clearing and urban development have resulted in the following land use breakdown in the watershed: 69.4 percent wooded/open, 22.1 percent agriculture, 7.1 percent developed, and 1.4 percent open water and extractive (Figure 2-3).

From 1950 through 2008, the Bay watershed's population doubled, increasing from 8.3 million to 16.8 million. The 8-year period from 2000 to 2008 witnessed population growth of approximately 7 percent from 15.7 million. Today, nearly 17 million people live in the watershed. According to census data, the watershed's population is growing by about 157,000 per year. Projections through 2030 are for the population to reach approximately 20 million (Figure 2-4).



Source: USGS CBPO

Figure 2-3. Chesapeake Bay watershed land cover.



Source: CBP Office Bay Barometer 2009

Figure 2-4. Reported and projected human population growth in the Chesapeake Bay watershed 1950–2030.

2.2 Chesapeake Bay TMDL Scope

The Chesapeake Bay TMDL is the largest, most complex TMDL in the country, covering a 64,000-square-mile area in the seven jurisdictions. EPA is establishing a federal TMDL for the tidal segments of the Chesapeake Bay and its tidal tributaries and embayments that are impaired for aquatic life uses due to excessive loads of nutrients (nitrogen and phosphorus) and sediment and listed on the four tidal Bay jurisdictions' respective CWA 2008 section 303(d) lists of impaired waters. The Bay TMDL also allocates loadings of nitrogen, phosphorus, and sediment to sources contributing those pollutants in all seven jurisdictions in the Bay watershed—Delaware, the District of Columbia, Maryland, New York, Pennsylvania, Virginia, and West Virginia.

As described more fully in Section 2.2.1 below, the Chesapeake Bay TMDL addresses only the restoration of aquatic life uses for the Bay and its tidal tributaries that are impaired from excess nitrogen, phosphorus, and sediment. If Bay segments are impaired for other pollutants, EPA expects that the jurisdictions will develop separate TMDLs to address those pollutants.

Thousands of previously approved TMDLs have been established to protect local waters across the Chesapeake Bay watershed. While many addressed other pollutants, some addressed nitrogen, phosphorus, and/or sediment. For watersheds and waterbodies that have both local TMDLs and Chesapeake Bay TMDLs for nitrogen, phosphorus, and sediment, the more stringent of the TMDLs will apply. In some cases, the reductions required to meet local conditions shown in existing TMDLs may be more stringent than those needed to meet Bay requirements, and vice versa.

2.2.1 Pollutants of Concern

The pollutants of concern for this TMDL are nutrients—nitrogen and phosphorus—and sediment. Excessive nutrients in the Chesapeake Bay and its tidal tributaries promote a number of undesirable water quality conditions such as excessive algal growth, low DO, and reduced water clarity (Smith et al. 1992; Kemp et al. 2005). The effect of nutrient loads on water quality and living resources can vary considerably by season and region.

Sediment suspended in the water column reduces the amount of light available to support healthy and extensive SAV or underwater Bay grass communities (Dennison et al. 1993; Kemp et al. 2004). The relative contribution of suspended sediment and algae that causes poor light conditions varies with location in the Bay tidal waters (Gallegos 2001).

Sediment also can contain other pollutants. For example, *Escherichia coli* often clings to sediment. By reducing sediment, reductions in phosphorus deliveries to the Bay (and possibly other pollutants such as *E. coli*) will also occur. However, EPA is not providing allocations for *E. coli* or other additional pollutants in this TMDL.

If Bay segments are impaired for other pollutants, EPA expects that the jurisdictions will develop separate TMDLs to address those pollutants. Because of the actions taken to achieve the Chesapeake Bay TMDL, direct benefits to local water quality conditions in surface waters throughout the Chesapeake Bay watershed will also occur.

2.2.2 Chesapeake Bay Program Segmentation Scheme

For 27 years, the CBP partners have used various versions of a basic segmentation scheme to organize the collection, analysis, and presentation of environmental data relating to the Chesapeake Bay. The *Chesapeake Bay Program Segmentation Scheme: Revisions, Decisions and Rationales* provides documentation of the spatial segmentation scheme of the Chesapeake Bay and its tidal tributaries and the later revisions and changes over almost three decades (USEPA 1983b, 2004b, 2005, 2008a).

Segmentation is the compartmentalization of the estuary into subunits on the basis of selection criteria (USEPA 2008a). The 92-segment scheme used in the Chesapeake Bay was derived from the 2004 published 78-segment scheme with additional jurisdictional boundary lines imposed to create 89 segments (USEPA 2004b, 2008a). The scheme includes only the split segments¹² agreed on for the tidal James and Potomac rivers for a total of 92 segments (Figure 2-5) (Table 2-1) (USEPA 2008a). The 92 individual watersheds that drain directly into one of the 92 Chesapeake Bay segments are referred to in this document as *Bay segment watersheds* (Figure 2-6).

Table 2-1 lists the eight major river basins draining to the Chesapeake Bay and their associated Bay segments with information related to each Bay segment's 2008 section 303(d) list status and whether the Bay segment is addressed by a consent decree or MOU. The 303(d) list categories are as follows:

¹² A split segment refers to when an established tidal Bay segment was fully bisected for purposes of applying different water quality criteria specific to two different portions of the same segment—in the case of the James River, or different assessments of attainment of the same applicable criteria separately from the main river segment—in the case of the Potomac River.

Source: USEPA 2008a

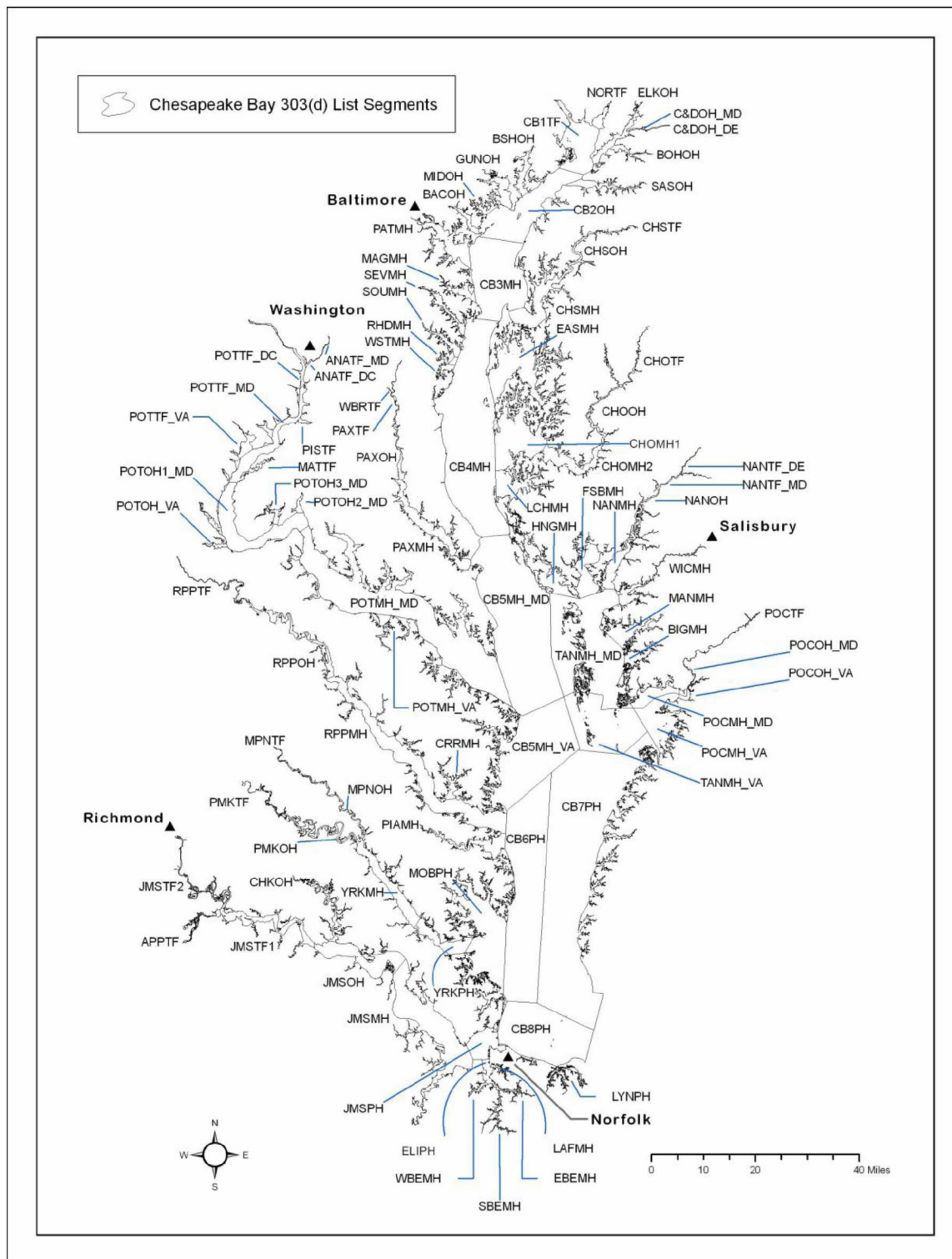


Figure 2-5. The 92 Chesapeake Bay segments.

- Category 1—attaining all WQS
- Category 2—attaining some WQS
- Category 3—insufficient information to determine if WQS are attained
- Category 4—impaired or threatened waters that do not need or have already completed a TMDL
 - 4a—TMDL has been completed
 - 4b—Other pollution control requirements are reasonably expected to result in the attainment of the WQS in the near future
 - 4c—Impairment is not caused by a pollutant
- Category 5—impaired or threatened water that requires a TMDL

Most Bay segments are listed as category 5 (impaired for most/all designated uses); exceptions are noted in Table 2-1.

Table 2-1. The Chesapeake Bay 303(d) tidal segments with consent decree (CD)/memorandum of understanding (MOU) and 303(d) listing status by major river basin and jurisdiction

Major river basin	Juris-diction	Chesapeake Bay 303(d) segment	Segment ID	CD/MOU	2008 list status ^a
Eastern Shore	MD	Big Annemessex River	BIGMH	--	5
	MD	Bohemia River	BOHOH	MD MOU	4a for TN and TP
	DE	C&D Canal, DE	C&DOH_DE	--	5
	MD	C&D Canal, MD	C&DOH_MD	MD MOU	5
	MD	Eastern Bay	EASMH	MD MOU	5
	VA	Eastern Lower Chesapeake Bay	CB7PH	VA CD	5
	MD	Elk River	ELKOH	MD MOU	5
	MD	Fishing Bay	FSBMH	MD MOU	4a for TN and TP
	MD	Honga River	HNGMH	MD MOU	5
	MD	Little Choptank River	LCHMH	MD MOU	5
	MD	Lower Chester River	CHSMH	MD MOU	5
	MD	Lower Choptank River	CHOMH2	MD MOU	5
	MD	Lower Nanticoke River	NANMH	--	5
	MD	Lower Pocomoke River, MD	POCMH_MD	MD MOU	5
	VA	Lower Pocomoke River, VA	POCMH_VA	VA CD	5
	MD	Manokin River	MANMH	MD MOU	4a for TN and TP
	MD	Middle Chester River	CHSOH	MD MOU	4a for TN and TP
	MD	Middle Choptank River	CHOOH	MD MOU	5
	MD	Middle Nanticoke River	NANOH	MD MOU	5
	MD	Middle Pocomoke River, MD	POCOH_MD	MD MOU	5
	VA	Middle Pocomoke River, VA	POCOH_VA	--	5
	MD	Mouth of Choptank River	CHOMH1	MD MOU	5
	MD	Northeast River	NORTF	MD MOU	4a for TN and TP

Major river basin	Jurisdiction	Chesapeake Bay 303(d) segment	Segment ID	CD/MOU	2008 list status ^a
	MD	Sassafras River	SASOH	MD MOU	4a for TP
	MD	Tangier Sound, MD	TANMH_MD	MD MOU	5
	VA	Tangier Sound, VA	TANMH_VA	--	5
	MD	Upper Chester River	CHSTF	MD MOU	4a for TN and TP
	MD	Upper Choptank River	CHOTF	MD MOU	5
	DE	Upper Nanticoke, DE	NANTF_DE	DE CD finished	5
	MD	Upper Nanticoke, MD	NANTF_MD	MD MOU	5
	MD	Upper Pocomoke River	POCTF	MD MOU	5
	MD	Wicomico River	WICMH	MD MOU	5
	VA	Appomattox River	APPTF	--	5
James	VA	Chickahominy River	CHKOH	--	5
	VA	Eastern Branch Elizabeth River	EBEMH	VA CD	5
	VA	Lafayette River	LAFMH	--	5
	VA	Lower James River	JMSMH	VA CD	5
	VA	Lynnhaven River	LYNPH	VA CD	5
	VA	Middle James River	JMSOH	VA CD	5
	VA	Mouth of Chesapeake Bay	CB8PH	--	5
	VA	Mouth of James River	JMSPH	VA CD	5
	VA	Mouth to mid-Elizabeth River	ELIPH	VA CD	5
	VA	Southern Branch Elizabeth River	SBEMH	VA CD	5
	VA	Upper James River - Lower	JMSTF1	VA CD	5
	VA	Upper James River - Upper	JMSTF2	VA CD	5
	VA	Western Branch Elizabeth River	WBEMH	VA CD	5
	MD	Lower Patuxent River	PAXMH	MD MOU	5
	MD	Middle Patuxent River	PAXOH	MD MOU	5
Patuxent	MD	Upper Patuxent River	PAXTF	MD MOU	5
	MD	Western Branch Patuxent River	WBRTF	MD MOU	BOD TMDL completed for DO impairments; 4a for BOD
	DC	Anacostia River, DC	ANATF_DC	DC CD	3 for DO; 4a for BOD, TN, TP and TSS
	MD	Anacostia River, MD	ANATF_MD	MD MOU	4a for BOD, TN, TP and TSS
Potomac	VA	Lower Central Chesapeake Bay, VA ^b	CB5MH_VA ^b	VA CD	5
	MD	Lower Potomac River, MD	POTMH_MD	MD MOU	5
	VA	Lower Potomac River, VA	POTMH_VA	VA CD	5
	MD	Mattawoman Creek	MATTF	MD MOU	5

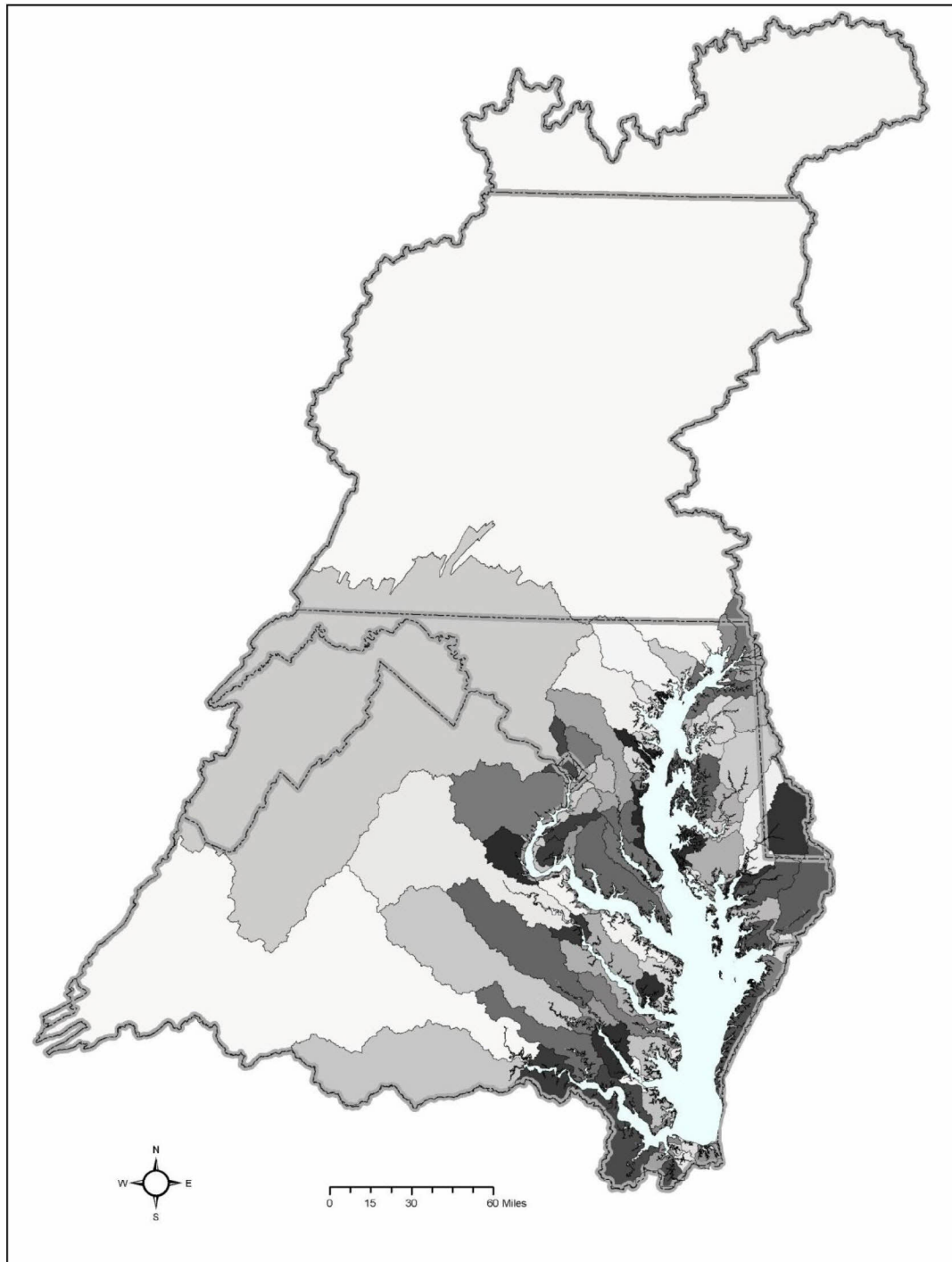
Major river basin	Jurisdiction	Chesapeake Bay 303(d) segment	Segment ID	CD/MOU	2008 list status ^a
	MD	Middle Potomac River, MD - Mainstem	POTOH1_MD	MD MOU	5
	MD	Middle Potomac River, MD - Nangemoy Creek	POTOH2_MD	MD MOU	5
	MD	Middle Potomac River, MD - Port Tobacco River	POTOH2_MD	MD MOU	4a for TN and TP
	VA	Middle Potomac River, VA	POTOH_VA	--	3 for DO in Migratory Spawning and Nursery (MSN); 2 for SAV and DO in open water
	MD	Piscataway Creek	PISTF	MD MOU	5
	DC	Upper Potomac River, DC	POTTF_DC	DC CD	3 for DO, 5 for pH
	MD	Upper Potomac River, MD	POTTF_MD	MD MOU	5
	VA	Upper Potomac River, VA	POTTF_VA	--	3 for DO in Migratory Spawning and Nursery; 2 for SAV and DO in open water
Rappahannock	VA	Corrotoman River	CRRMH	--	5
	VA	Lower Rappahannock River	RPPMH	VA CD	5
	VA	Middle Rappahannock River	RPPOH	--	3 for DO in Migratory Spawning and Nursery; 2 for SAV and DO in open water
	VA	Upper Rappahannock River	RPPTF	--	5
	VA	Western Lower Chesapeake Bay ^b	CB6PH ^b	VA CD	5
Susquehanna	MD	Northern Chesapeake Bay ^b	CB1TF ^b	MD MOU	5
Western Shore	MD	Back River	BACOH	MD MOU	4a for TN and TP
	MD	Bush River	BSHOH	MD MOU	5
	MD	Gunpowder River	GUNOH	MD MOU	5
	MD	Lower Central Chesapeake Bay, MD ^b	CB5MH_MD ^b	MD MOU	5
	MD	Magothy River	MAGMH	MD MOU	5
	MD	Middle Central Chesapeake Bay ^b	CB4MH ^b	MD MOU	5
	MD	Middle River	MIDOH	MD MOU	5
	MD	Patapsco River	PATMH	MD MOU	5
	MD	Rhode River	RHDMH	MD MOU	5
	MD	Severn River	SEVMH	MD MOU	5
	MD	South River	SOU MH	MD MOU	5
	MD	Upper Central Chesapeake Bay ^b	CB3MH ^b	MD MOU	5
	MD	Upper Chesapeake	CB2OH ^b	MD MOU	5

Major river basin	Juris-diction	Chesapeake Bay 303(d) segment	Segment ID	CD/MOU	2008 list status ^a
		Bay ^b			
	MD	West River	WSTMH	MD MOU	5
York	VA	Lower Mattaponi River	MPNOH	VA CD	5
	VA	Lower Pamunkey River	PMKOH	VA CD	5
	VA	Lower York River	YRKPH	VA CD	5
	VA	Middle York River	YRKMH	VA CD	5
	VA	Mobjack Bay	MOBPH	--	5
	VA	Piankatank River	PIAMH	--	5
	VA	Upper Mattaponi River	MPNTF	VA CD	5
	VA	Upper Pamunkey River	PMKTF	VA CD	5

Sources: American Canoe Association v. EPA; American Littoral Society, et al. v. EPA, et al.; DC DOE 2008; DE DNREC 2008; Kingman Park Civic Association, et al. vs. EPA; MDE 1998, 2004, 2008; USEPA 2008 a; VA DEQ 2008

a. BOD = biological oxygen demand; DO = dissolved oxygen; TN = total nitrogen; TP = total phosphorus; TSS = total suspended solids

b. More than one river basin flows into this tidal segment



Source: USEPA 2008a

Figure 2-6. The 92 Chesapeake Bay segment watersheds.

2.2.3 *Jurisdictions' 2008 303(d) Listings*

The Chesapeake Bay TMDL is based on the most recent EPA-approved tidal Bay jurisdictions' section 303(d) lists, which are the 2008 303(d) listings.¹³ Those section 303(d) lists document 89 of the 92 Chesapeake Bay segments as impaired on either Category 4a (impaired, TMDL has been developed) or Category 5 (impaired, needs TMDL) because of various factors, including low DO levels, insufficient SAV, excess chlorophyll *a*, biological/nutrient indicators, total nitrogen, total phosphorus, total suspended solids (TSS), biological oxygen demand (BOD), and pH (caused by excessive nutrients fueling algal blooms) (DC DOE 2008; DE DNREC 2008; MDE 2008; VADEQ 2008).

Three Chesapeake Bay segments are not listed in Category 4a or 5 on Virginia's 2008 integrated report:

- Upper Potomac River (POTTF_VA)
- Middle Potomac River (POTOH_VA)
- Middle Rappahannock River (RPPOH)

Those three segments are listed as either Category 2 (some uses met, other uses have insufficient information to determine impairment) or Category 3 (insufficient information to determine if impaired) (VA DEQ 2008). Because their listing status raises a reasonable question as to whether those three segments are impaired, and because those segments are tidally interconnected with other impaired Bay segments, it is appropriate that they also be addressed by the Chesapeake Bay TMDL.

The first segment, Virginia's Upper Potomac River (POTTF_VA), encompasses a series of small tidal embayments that are tidally interconnected with Maryland's Upper Potomac River (POTTF_MD) segment and the District of Columbia's Upper Potomac River (POTTF_DC) segment (USEPA 2008a), both of which are listed as Category 5 of Maryland's and the District of Columbia's respective 2008 integrated reports (DCDOE 2008; MDE 2008). Loads originating in the watershed that drains directly Virginia's Upper Potomac River segment influence the water quality in the two adjacent Maryland and District of Columbia impaired tidal segments and other down-tide segments.

The second segment, Virginia's Middle Potomac River (POTOH_VA), also encompasses a series of small tidal embayments that are tidally interconnected with Maryland's Middle Potomac River (POTOH_MD) segment (USEPA 2008a), which is listed as Category 5 on Maryland's 2008 integrated report (MDE 2008). Loads originating in the watershed that drains directly to Virginia's Middle Potomac River segment influence the water quality in the adjacent Maryland impaired tidal segment and other down-tide segments.

The third segment, Virginia's Middle Rappahannock River (RPPOH), is tidally interconnected with both the Lower Rappahannock River (RPPMH) and the Upper Rappahannock River (RPPTF) segments (USEPA 2008a), both of which are listed as Category 5 on Virginia's 2008

¹³ At the time EPA applied the Bay models for development of the allocations, the 2008 section 303(d) lists were the most recent lists. Although EPA subsequently received final 2010 section 303(d) lists for approval from all tidal jurisdictions except Virginia (Virginia draft 2010 section 303(d) list released for public review on August 23, 2010), EPA used the 2008 lists in establishing the Bay TMDL to have a consistent basis for the TMDL.

integrated report (VADEQ 2008). Loads originating in the watershed that drains directly to Virginia's Middle Rappahannock River segment influence the water quality in the adjacent Virginia impaired tidal segments and other down-tide segments.

As detailed in Section 9, TMDLs have been completed as part of the Chesapeake Bay TMDL for all 92 Chesapeake Bay segments listed in Table 2-1 (see Section 9) including the above described three Virginia Bay segments because they flow into impaired tidal Bay segments, and reductions in nutrient and sediment loadings from their respective watersheds, therefore, are necessary to achieve the Bay jurisdictions' Chesapeake Bay WQS.

2.2.4 2008 303(d) Listing Segments Compared to Consent Decree and MOU Segments

To ensure that TMDLs were completed for all Bay segments for which they are legally required—all 2008 listed segments, all Virginia, Delaware, and District of Columbia TMDL consent decree segments, and all Maryland MOU segments—EPA compared the 2008 listed segments with those included on those agreements (Table 2-1). In total, 77 segments are addressed by the Virginia and District of Columbia consent decrees and the Maryland MOU: 22 segments are on the Virginia TMDL consent decree; 2 segments are on the Delaware consent decree; 2 segments are on the District of Columbia TMDL consent decree; and 51 segments are on the Maryland TMDL MOU (Table 2-2). The evaluation found that all the Virginia consent decree, Delaware consent decree, District of Columbia consent decree, and Maryland MOU segments are a subset of the total list of 92 Chesapeake Bay segments for which TMDLs have been established under the Bay TMDL.

Table 2-2. Comparison of consent decree/MOU segments with total number of Bay segments

Jurisdiction	Consent decree or MOU segments	Chesapeake Bay segments
Virginia	22	35
District of Columbia	2	2
Maryland	51	53
Delaware	2 ^a	2
Total	77	92

Adapted from Table 2-1.

a. Two consent decrees affect one Bay segment each in Delaware, but TMDLs have already been established for both segments.

SECTION 3. CHESAPEAKE BAY WATER QUALITY STANDARDS

WQS consist of four basic elements: designated uses, water quality criteria, an antidegradation policy (to maintain and protect existing uses and high-quality waters), and general policies (addressing implementation issues such as low flows, variances, and mixing zones). Designated uses are a jurisdiction's goals and expectations for each of the individual surface waters (e.g., coldwater fisheries, public water supply, and primary contact recreation). EPA's WQS regulation defines designated uses as the "uses specified in WQS for each waterbody or segment, whether or not they are being attained" (40 CFR 131.3). Water quality criteria may be numeric or narrative, and represent a quality of water that supports a particular use. When water quality criteria are met, water quality is expected to protect its designated use. Numeric water quality criteria are chemical-specific and are based on specific levels of pollutants consistent with the water's designated uses (e.g., physical or chemical characteristics like temperature, minimum concentration of DO, and the maximum concentrations of toxic pollutants).

Starting in 1986, EPA and its CBP partners embarked on a process to synthesize scientific evidence on the water quality requirements of hundreds of aquatic species and biological communities. The 1987 Chesapeake Bay Agreement includes a commitment to, "develop and adopt guidelines for the protection of water quality and habitat conditions necessary to support the living resources found in the Chesapeake Bay system, and to use these guidelines in the implementation of water quality and habitat quality programs" (CEC 1987). The CBP partnership initially published two syntheses of the available scientific findings supporting establishment of habitat requirements for 31 target species (CBP 1987; Funderburk et al. 1991). Those efforts spawned development and publication of synthesis documents focused on DO requirements (Jordan et al. 1991) and underwater Bay grasses habitat requirements (Batiuk et al. 1992, 2000). On the basis of that work, in part, EPA published as guidance the Chesapeake Bay water quality criteria (USEPA 2003a) and the Chesapeake Bay refined aquatic life designated uses and attainability document (USEPA 2003c). Guided by those efforts, Delaware, the District of Columbia, Maryland, and Virginia adopted jurisdiction-specific Chesapeake Bay WQS regulations in 2004–2005 consistent with the EPA published guidance. EPA then reviewed and approved the four tidal Bay jurisdictions' WQS submissions pursuant to CWA section 303(c).

Maryland, Virginia, and the District have each proposed very specific amendments to their respective Chesapeake Bay WQS regulations. The proposed amendments are described in Section 3.2.5.

3.1 Chesapeake Bay Water Quality Criteria and Designated Uses

The above described DO, underwater Bay grasses and Bay habitat requirements documents (Batiuk et al 1992, 2000; CBP 1987; Funderburk et al. 1991; Jordan et al. 1991), supplemented by additional scientific research findings, provided the basis for developing the applicable water quality criteria guidance for the Chesapeake Bay. That guidance is in EPA's Bay criteria (USEPA 2003a) and designated uses/attainability (USEPA 2003c) documents and their subsequent addenda (USEPA 2004a, 2004b, 2004e, 2005, 2007a, 2007b, 2008a, 2010a). EPA Region 3 published those documents as guidance in accordance with CWA sections 117(b) and 303 to derive water quality criteria specifically for addressing the critical nutrient and sediment

enrichment parameters necessary to protect designated aquatic life uses in the Bay (Table 3-1). These criteria serve as surrogate numeric criteria for nitrogen, phosphorus, and sediment.

Table 3-1. Chesapeake Bay water quality criteria and designated use related documentation and addenda

Document title	Month/year published	Document content and description
<i>Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries</i> . EPA 903-R-03-002. [USEPA 2003a]	April 2003	Original Chesapeake Bay water quality criteria document.
<i>Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability</i> . EPA 903-R-03-004. [USEPA 2003c]	October 2003	Original Chesapeake Bay tidal waters designated uses document.
<i>Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries—2004 Addendum</i> . EPA 903-R-03-002. [USEPA 2004a]	October 2004	Addresses endangered species protection, assessment of DO criteria, derivation of site-specific DO criteria, pycnocline boundary delineation methodology and updated water clarity criteria/SAV restoration acreage assessment procedures.
<i>Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability—2004 Addendum</i> . EPA 903-R-04-006. [USEPA 2004e]	October 2004	Addresses refinements to Bay tidal waters designated use boundaries, segmentation boundaries, Potomac River jurisdictional boundaries, and documents SAV no-grow zones, restoration goal, and shallow-water acreages.
<i>Chesapeake Bay Program Analytical Segmentation Scheme: Revisions, Decisions and Rationales 1983–2003</i> . EPA 903-R-04-008. CBP/TRS 268-04. [USEPA 2004b]	October 2004	Details documentation on the history of the segmentation schemes and coordinates, georeferences and narrative descriptions of the 2003 segmentation scheme.
<i>Chesapeake Bay Program Analytical Segmentation Scheme: Revisions, Decisions and Rationales 1983–2003: 2005 Addendum</i> . EPA 903-R-05-004. CBP/TRS 278-06. [USEPA 2005]	December 2005	Addresses methods used to subdivide the segments by jurisdiction and the coordinates, georeferences and narrative descriptions for those subdivided segments.
<i>Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries—2007 Addendum</i> . EPA 903-R-07-003. CBP/TRS 285-07. [USEPA 2007a]	July 2007	Addresses refinements to the Bay water quality DO, water clarity/SAV and chlorophyll a criteria assessment methodologies and documents the framework for Bay tidal waters 303(d) list decision making.
<i>Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries—2007 Chlorophyll Criteria Addendum</i> . EPA 903-R-07-005. CBP/TRS 288/07. [USEPA 2007b]	November 2007	Publishes a set of numerical chlorophyll a criteria for Chesapeake Bay and the supporting criteria assessment procedures.

Document title	Month/year published	Document content and description
<i>Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries—2008 Technical Support for Criteria Assessment Protocols Addendum.</i> EPA 903-R-08-001. CBP/TRS 290-08. [USEPA 2008a]	September 2008	Addresses refinements to the Bay water quality DO, water clarity/SAV and chlorophyll a criteria assessment methodologies and documents the 2008 92-segment scheme for Bay tidal waters.
<i>Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries—2010 Technical Support for Criteria Assessment Protocols Addendum.</i> EPA 903-R-10-002. [USEPA 2010a]	May 2010	Addresses refinements to procedures for defining designated uses, existing procedures for deriving biologically based reference curves for DO criteria assessment and chlorophyll criteria assessment procedures.

Before adoption into each Bay jurisdiction's WQS regulations, each set of criteria, criteria assessment procedures, designated uses, and proposed WQS were subject to extensive scientific, programmatic, and public review.

The original 2003 water quality criteria, assessment procedures, and designated uses went through independent scientific peer reviews sponsored by the CBP's STAC. The CBP's Water Quality Steering Committee's water quality criteria and designated use teams then reviewed and approved them. Finally, the CBP's Water Quality Steering Committee reviewed and approved them for EPA publication on behalf of the partnership.

Since the publication of the original Chesapeake Bay water quality criteria document (USEPA 2003a) and Chesapeake Bay designated uses and attainability document (USEPA 2003c), EPA has published significant changes to the water quality criteria and the criteria assessment procedures. Specifically, EPA has published five addenda—USEPA 2004a, 2007a, 2007b, 2008a, 2010a—to the original 2003 Bay criteria document (USEPA 2003a), one addendum—USEPA 2004e—to the original 2003 Bay designated use/attainability document (USEPA 2003c) and one addendum—USEPA 2005—to the original Bay segmentation document (USEPA 2004b) (see Table 3-1).

Those revisions have undergone independent scientific peer reviews, sponsored by the CBP's STAC, before review and approval by the CBP's Criteria Assessment Protocols Workgroup and then the Water Quality Steering Committee/Water Quality Implementation Team for EPA publication on behalf of the partnership. Examples include the cumulative frequency distribution approach (STAC 2006) and the biological reference curves (STAC 2009).

WQS revisions incorporating the most recent of these addenda are pending in the District of Columbia, Maryland, and Virginia. Virginia's WQS revisions also will incorporate the 2007 and 2008 addenda. Maryland, Virginia, Delaware, and the District of Columbia's processes for adopting amendments to their existing Chesapeake Bay WQS regulations require full public notice, public review and comment, and response to public comments before submission to EPA Region 3 for final EPA review and approval.

In this TMDL, EPA is proposing for public notice and comment two separate TMDLs—one based on current WQS and one based on changes to WQS being proposed by the tidal Bay jurisdictions. Those two sets of WQS are discussed more fully in Sections 3.2 and 3.3 below.

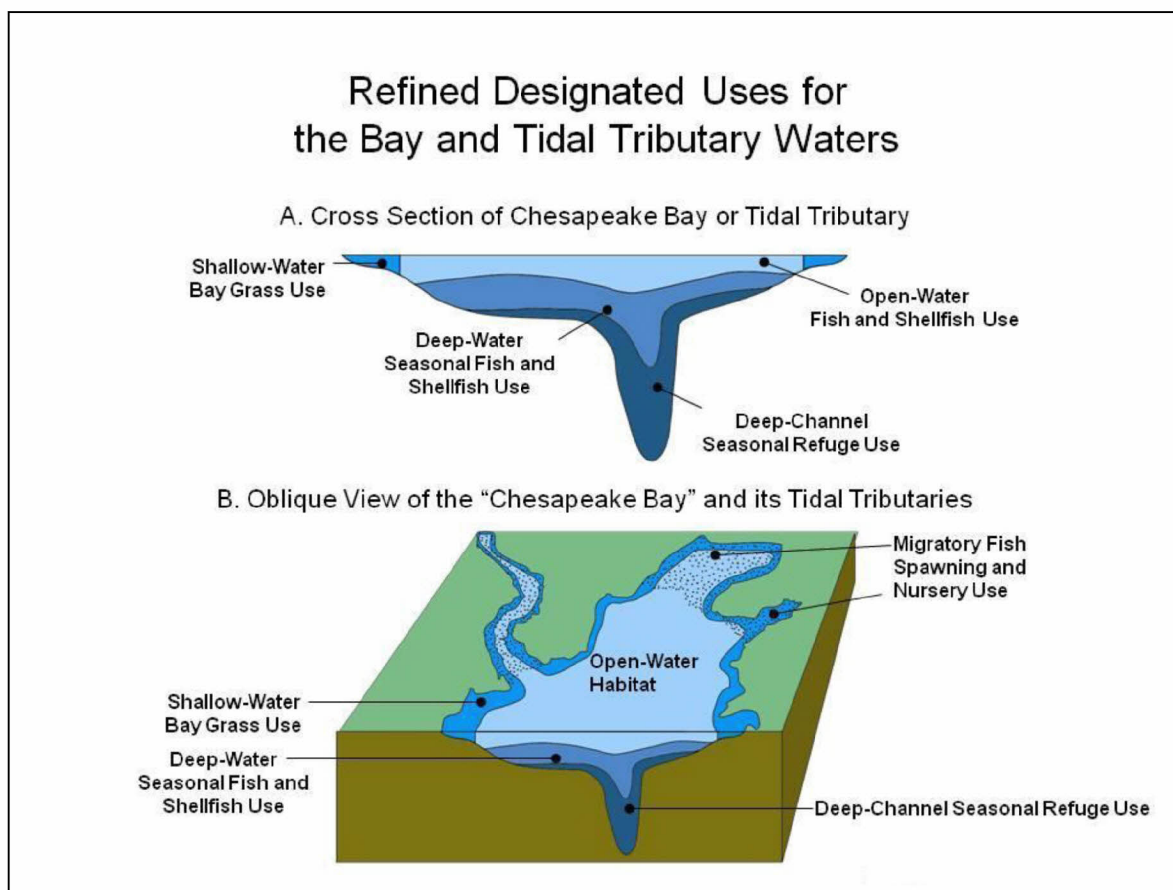
3.1.1 Tidal Water Designated Uses

EPA and its seven watershed jurisdiction partners agreed on five refined aquatic life designated uses reflecting the habitats of an array of recreationally, commercially, and ecologically important species and biological communities (USEPA 2003c, 2004e, 2010a). The five tidal Bay designated uses are applied, where appropriate, consistently across Maryland, Virginia, Delaware, and the District of Columbia's portions of the Chesapeake Bay and its tidal tributary and embayment waters. The vertical and horizontal breadth and temporal application of the designated use boundaries are based on a combination of natural factors, historical records, physical features, hydrology, bathymetry, and other scientific considerations (USEPA 2003c, 2004e, 2010a). Table 3-2 outlines the Chesapeake Bay tidal water designated uses, which are illustrated in Figure 3-1.

Table 3-2. Five Chesapeake Bay tidal waters designated uses

Tidal water designated use	Chesapeake Bay habitats and communities protected
Migratory fish spawning and nursery	Migratory and resident tidal freshwater finfish during the late winter/spring spawning and nursery season in tidal freshwater to low-salinity habitats.
Shallow-water bay grass	Underwater bay grasses and fish and crab species that depend on the shallow-water habitat provided by underwater bay grass beds.
Open-water fish and shellfish	Diverse populations of sport fish, including striped bass, bluefish, mackerel and sea trout, as well as important bait fish such as menhaden and silversides in surface water habitats within tidal creeks, rivers, embayments and the mainstem Chesapeake Bay year-round.
Deep-water seasonal fish and shellfish	Animals inhabiting the deeper transitional water column and bottom habitats between the well-mixed surface waters and the very deep channels during the summer months (e.g., bottom-feeding fish, crabs and oysters, as well as other important species, including the bay anchovy).
Deep-channel seasonal refuge	Bottom-sediment-dwelling worms and small clams that serve as food for bottom-feeding fish and crabs in the very deep channel in summer.

Sources: USEPA 2003c, 2004e



Source: USEPA 2003c

Figure 3-1. Conceptual illustration of the five Chesapeake Bay tidal water designated use zones.

Table 3-3 lists the designated uses for each of the 92 Chesapeake Bay segments pursuant to current WQS regulations.¹⁴ It originally was published as Table V-1 on pages 51–53 of the *Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries 2007 Addendum* (USEPA 2007a), which is an updated version of Table IV-3 originally published on pages 62–63 of the 2003 *Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability* (USEPA 2003c). The absence of an X in the shallow-water bay grass designated use column indicates that the Bay segment has been entirely delineated as an SAV no-grow zone and, therefore, the shallow-water Bay grass designated use does not apply to that Bay segment (USEPA 2004e).

¹⁴ Maryland is proposing adding the deep-water designated use to three Bay segments—MAGMH (Magothy River), SEVMH (Severn River), and SOUMH (South River)—as part of a set of proposed amendments to its Chesapeake Bay WQS regulations.

Table 3-3. Current tidal water designated uses by Chesapeake Bay segment

CBP segment name	CBP segment	Juris	Migratory spawning & nursery	Open water	Deep water	Deep channel	Shallow water
			Feb. 1–May 31	Year-round	June 1–Sept. 30	June 1–Sept. 30	SAV growing season
Northern Chesapeake Bay	CB1TF	MD	X	X			X
Upper Chesapeake Bay	CB2OH	MD	X	X			X
Upper Central Chesapeake Bay	CB3MH	MD	X	X	X	X	X
Middle Central Chesapeake Bay	CB4MH	MD	X	X	X	X	X
Lower Central Chesapeake Bay	CB5MH_MD	MD		X	X	X	X
Lower Central Chesapeake Bay	CB5MH_VA	VA		X	X	X	X
Western Lower Chesapeake Bay	CB6PH	VA		X	X		X
Eastern Lower Chesapeake Bay	CB7PH	VA		X	X		X
Mouth of the Chesapeake Bay	CB8PH	VA		X			X
Bush River	BSHOH	MD	X	X			X
Gunpowder River	GUNOH	MD	X	X			X
Middle River	MIDOH	MD	X	X			X
Back River	BACOH	MD	X	X			X*
Patapsco River	PATMH	MD	X	X	X		X
Magothy River	MAGMH	MD	X	X			X
Severn River	SEVMH	MD	X	X			X
South River	SOUMH	MD	X	X			X
Rhode River	RHDMH	MD	X	X			X
West River	WSTMH	MD	X	X			X
Upper Patuxent River	PAXTF	MD	X	X			X
Western Branch (Patuxent R.)	WBRTF	MD	X	X			X*
Middle Patuxent River	PAXOH	MD	X	X			X
Lower Patuxent River	PAXMH	MD	X	X	X		X
Upper Potomac River	POTTF_DC	DC	X	X			X
Upper Potomac River	POTTF_MD	MD	X	X			X
Upper Potomac River	POTTF_VA	VA	X	X			X
Anacostia River	ANATF_DC	DC	X	X			X

CBP segment name	CBP segment	Juris	Migratory spawning & nursery	Open water	Deep water	Deep channel	Shallow water
			Feb. 1–May 31	Year-round	June 1–Sept. 30	June 1–Sept. 30	SAV growing season
Anacostia River	ANATF_MD	MD	X	X			X
Piscataway Creek	PISTF	MD	X	X			X
Mattawoman Creek	MATTF	MD	X	X			X
Middle Potomac River	POTOH1	MD	X	X			X
Middle Potomac River	POTOH2	MD	X	X			X
Middle Potomac River	POTOH3	MD	X	X			X
Middle Potomac River	POTOH	VA	X	X			X
Lower Potomac River	POTMH	MD	X	X	X	X	X
Lower Potomac River	POTMH	VA	X	X	X	X	X
Upper Rappahannock River	RPPTF	VA	X	X			X
Middle Rappahannock River	RPPOH	VA	X	X			X*
Lower Rappahannock River	RPPMH	VA	X	X	X	X	X
Corrotoman River	CRRMH	VA	X	X			X
Piankatank River	PIAMH	VA		X			X
Upper Mattaponi River	MPNTF	VA	X	X			X
Lower Mattaponi River	MPNOH	VA	X	X			X*
Upper Pamunkey River	PMKTF	VA	X	X			X
Lower Pamunkey River	PMKOH	VA	X	X			X*
Middle York River	YRKMH	VA	X	X			X
Lower York River	YRKPH	VA		X	X		X
Mobjack Bay	MOBPH	VA		X			X
Upper James River-Lower	JMSTF1	VA	X	X			X
Upper James River-Upper	JMSTF2	VA	X	X			X
Appomattox River	APPTF	VA	X	X			X
Middle James River	JMSOH	VA	X	X			X
Chickahominy River	CHKOH	VA	X	X			X

CBP segment name	CBP segment	Juris	Migratory spawning & nursery	Open water	Deep water	Deep channel	Shallow water
			Feb. 1–May 31	Year-round	June 1–Sept. 30	June 1–Sept. 30	SAV growing season
Lower James River	JMSMH	VA	X	X			X
Mouth of the James River	JMSPH	VA		X			X
Western Branch Elizabeth River	WBEMH	VA		X			
Southern Branch Elizabeth River	SBEMH	VA		X			
Eastern Branch Elizabeth River	EBEMH	VA		X			
Lafayette River	LAFMH	VA		X			
Mouth of the Elizabeth River	ELIPH	VA		X	X	X	
Lynnhaven River	LYNPH	VA		X			X
Northeast River	NORTF	MD	X	X			X
C&D Canal	C&DOH_DE	DE	X	X			X
C&D Canal	C&DOH_MD	MD	X	X			X
Bohemia River	BOHOH	MD	X	X			X
Elk River	ELKOH	MD	X	X			X
Sassafras River	SASOH	MD	X	X			X
Upper Chester River	CHSTF	MD	X	X			X*
Middle Chester River	CHSOH	MD	X	X			X
Lower Chester River	CHSMH	MD	X	X	X	X	X
Eastern Bay	EASMH	MD		X	X	X	X
Upper Choptank River	CHOTF	MD	X	X			
Middle Choptank River	CHOOH	MD	X	X			X
Lower Choptank River	CHOMH 2	MD	X	X			X
Mouth of the Choptank River	CHOMH 1	MD	X	X			X
Little Choptank River	LCHMH	MD		X			X
Honga River	HNGMH	MD		X			X
Fishing Bay	FSBMH	MD	X	X			X
Upper Nanticoke River	NANTF_MD	MD	X	X			
Upper Nanticoke River	NANTF_DE	DE	X	X			X*
Middle Nanticoke River	NANOH	MD	X	X			X

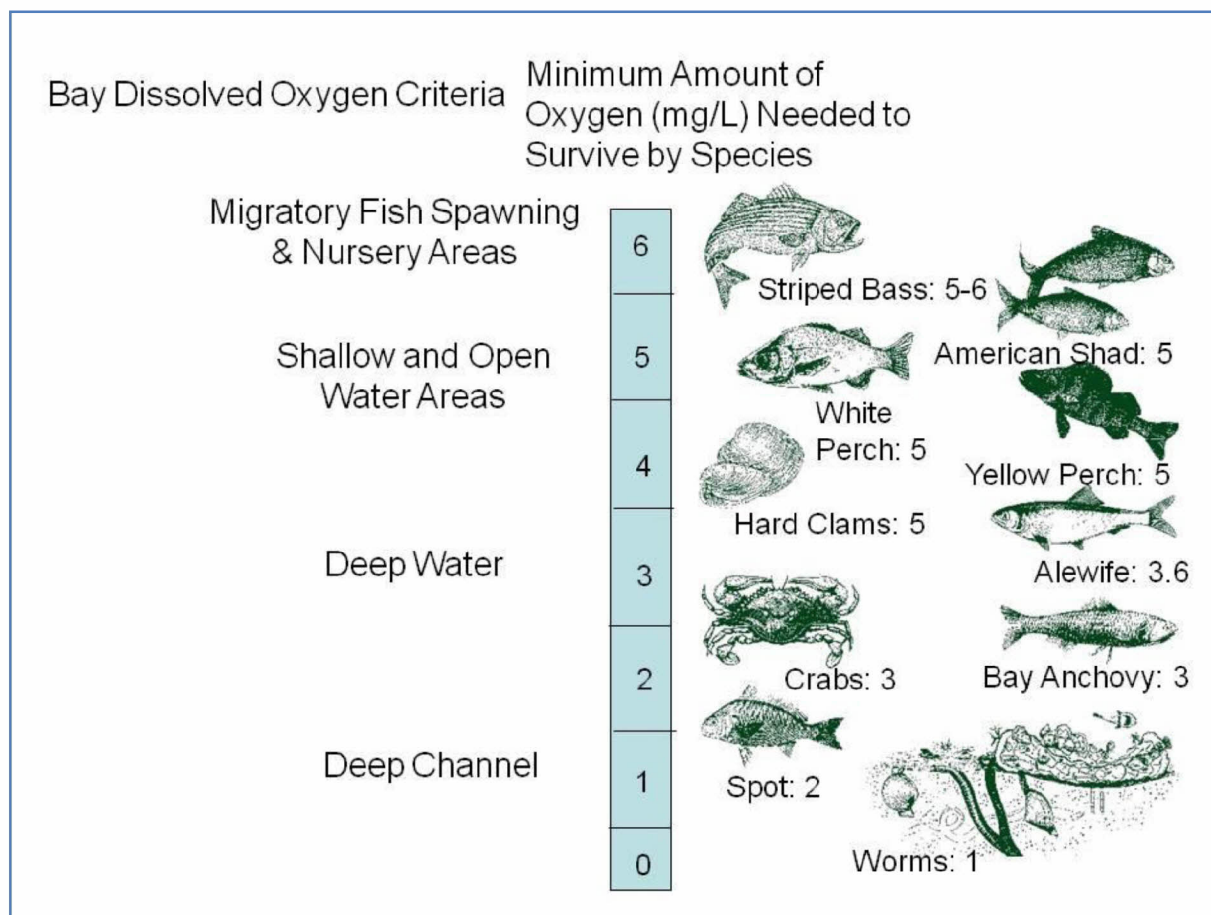
CBP segment name	CBP segment	Juris	Migratory spawning & nursery	Open water	Deep water	Deep channel	Shallow water
			Feb. 1–May 31	Year-round	June 1–Sept. 30	June 1–Sept. 30	SAV growing season
Lower Nanticoke River	NANMH	MD	X	X			X
Wicomico River	WICMH	MD	X	X			X
Manokin River	MANMH	MD	X	X			X
Big Annemessex River	BIGMH	MD	X	X			X
Upper Pocomoke River	POCTF	MD	X	X			
Middle Pocomoke River	POCOH_MD	MD	X	X			X*
Middle Pocomoke River	POCOH_VA	VA	X	X			X*
Lower Pocomoke River	POCMH_MD	MD	X	X			X
Lower Pocomoke River	POCMH_VA	VA	X	X			X
Tangier Sound	TANMH_MD	MD		X			X
Tangier Sound	TANMH_VA	VA		X			X

An asterisk (*) indicates that no numerical SAV restoration acreage goal was published in 2003 for the shallow-water bay grass designated use of that segment (USEPA 2003c).

3.1.2 Dissolved Oxygen Criteria

Oxygen is one of the most essential environmental constituents supporting life. In the Chesapeake Bay's deeper waters, there is a natural tendency toward reduced DO conditions because of the Bay's physical morphology and estuarine circulation. The Chesapeake Bay's highly productive shallow waters, coupled with strong density stratification; long residence times (weeks to months); low tidal energy; and tendency to retain, recycle, and regenerate nutrients from the surrounding watershed all set the stage for low DO conditions.

Against that backdrop, EPA worked closely with its seven watershed partners and the larger Bay scientific community to derive and publish a set of DO criteria to protect specific aquatic life communities and reflect the Chesapeake Bay's natural processes that define distinct habitats (Figure 3-2) (USEPA 2003a; Batiuk et al. 2009). Working with the National Marine Fisheries Service, EPA also ensured that the criteria were protective of the shortnose sturgeon, a species listed as endangered by the Endangered Species Act (NMFS 2003).



Source: USEPA 2003a

Figure 3-2. DO (mg/L) concentrations required by different Chesapeake Bay species and biological communities.

Criteria for the migratory fish spawning and nursery, shallow-water Bay grass and open-water fish and shellfish designated uses were set at levels to prevent impairment of growth and to protect the reproduction and survival of all organisms living in the open-water column habitats (Table 3-4) (USEPA 2003a). Criteria for deep-water seasonal fish and shellfish designated use habitats during seasons when the water column is significantly stratified were set at levels to protect juvenile and adult fish, shellfish, and the recruitment success of the Bay anchovy. Criteria for deep-channel seasonal refuge designated use habitats in summer were set to protect the survival of bottom sediment-dwelling worms and clams.

Table 3-4. Current Chesapeake Bay DO criteria

Designated use	Criteria concentration/duration	Protection provided	Temporal application
Migratory fish spawning and nursery use	7-day mean ≥ 6 mg/L (tidal habitats with 0–0.5 ppt salinity)	Survival/growth of larval/juvenile tidal-fresh resident fish; protective of threatened/endangered species	February 1–May 31
	Instantaneous minimum ≥ 5 mg/L	Survival and growth of larval/juvenile migratory fish; protective of threatened/endangered species	
	Open-water fish and shellfish designated use criteria apply		June 1–January 31
Shallow-water bay grass use	Open-water fish and shellfish designated use criteria apply		Year-round
Open-water fish and shellfish use	30-day mean ≥ 5.5 mg/L (tidal habitats with 0–0.5 ppt salinity)	Growth of tidal-fresh juvenile and adult fish; protective of threatened/endangered species	Year-round
	30-day mean ≥ 5 mg/L (tidal habitats with >0.5 ppt salinity)	Growth of larval, juvenile, and adult fish and shellfish; protective of threatened/endangered species	
	7-day mean ≥ 4 mg/L	Survival of open-water fish larvae	
	Instantaneous minimum ≥ 3.2 mg/L	Survival of threatened/endangered sturgeon species ^a	
Deep-water seasonal fish and shellfish use	30-day mean ≥ 3 mg/L	Survival and recruitment of Bay anchovy eggs and larvae	June 1–September 30
	1-day mean ≥ 2.3 mg/L	Survival of open-water juvenile and adult fish	
	Instantaneous minimum ≥ 1.7 mg/L	Survival of Bay anchovy eggs and larvae	
	Open-water fish and shellfish designated use criteria apply		October 1–May 31
Deep-channel seasonal refuge use	Instantaneous minimum ≥ 1 mg/L	Survival of bottom-dwelling worms and clams	June 1–September 30
	Open-water fish and shellfish designated use criteria apply		October 1–May 31

Source: USEPA 2003a

Notes: mg/L = milligrams per liter; ppt = parts per thousand salinity

a. At temperatures considered stressful to shortnose sturgeon (> 29 degrees Celsius), DO concentrations above an instantaneous minimum of 4.3 mg/L will protect survival of this listed sturgeon species.

3.1.3 Chlorophyll *a* Criteria

EPA's 2003 *Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll *a* for the Chesapeake Bay and Its Tidal Tributaries* (USEPA 2003a) describes the applicable narrative criteria for chlorophyll *a*:

Concentrations of chlorophyll *a* in free-floating microscopic aquatic plants (algae) shall not exceed levels that result in ecologically undesirable consequences—such as reduced water clarity, low dissolved oxygen, food supply imbalances, proliferation of species deemed potentially harmful to aquatic life or humans or aesthetically objectionable conditions—or otherwise render tidal waters unsuitable for designated uses.

In 2007 EPA published numeric chlorophyll *a* criteria guidance protective of open-water designated use impairment by harmful algal blooms and provided recommended reference chlorophyll *a* concentrations for historic chlorophyll *a* levels, and DO and water clarity impairments (USEPA 2007a).

Delaware, the District of Columbia, Maryland, and Virginia all adopted EPA's narrative chlorophyll *a* criteria. Additionally, Virginia and the District of Columbia adopted EPA's numeric chlorophyll *a* criteria for certain tidal waters as detailed in Section 3.2.

3.1.4 Water Clarity/Underwater Bay Grasses Criteria

Underwater Bay grass beds create rich animal habitats that support the growth of diverse fish and invertebrate populations. Underwater Bay grasses, also referred to as submerged aquatic vegetation (SAV), help improve tidal water quality by retaining nutrients as plant material, stabilizing bottom sediments (preventing their resuspension) and reducing shoreline erosion. The health and survival of such underwater plant communities in the Chesapeake Bay and its tidal tributaries depend on suitable environmental conditions (Dennison et al. 1993; Kemp et al. 2004).

The loss of SAV from the shallow waters of the Chesapeake Bay, which was first noted in the early 1960s, is a widespread, well-documented problem (Orth and Moore 1983; Orth et al. 2010). The primary causes of the decline of SAV are nutrient over-enrichment, increased suspended sediment in the water, and associated reductions in light availability (Kemp et al. 2004). To restore the critical habitats and food sources, enough light must penetrate the shallow waters to support the survival, growth, and repropagation of diverse, healthy, SAV communities (Dennison et al. 1993).

EPA, working closely with its seven watershed partners and the larger Bay scientific community, derived and published Chesapeake Bay water clarity criteria to establish the minimum level of light penetration required to support the survival, growth, and continued propagation of SAV (USEPA 2003a). Chesapeake Bay-specific water clarity criteria were derived for low and higher salinity habitats using a worldwide literature synthesis, an evaluation of Chesapeake Bay-specific field study findings, and model simulation and diagnostic tools (Table 3-5).

Table 3-5. Summary of Chesapeake Bay water clarity criteria for application to shallow-water bay grass designated use habitats

Salinity regime	Water clarity criteria (percent light-through-water)	Water clarity criteria as Secchi depth ^a								Temporal application
		Water clarity criteria application depths (meters)								
		0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	
		Secchi depth for above criteria application depth (meters)								
Tidal-fresh	13%	0.2	0.4	0.5	0.7	0.9	1.1	1.2	1.4	April 1–Oct 31
Oligohaline	13%	0.2	0.4	0.5	0.7	0.9	1.1	1.2	1.4	April 1–Oct 31
Mesohaline	22%	0.2	0.5	0.7	1.0	1.2	1.4	1.7	1.9	April 1–Oct 31
Polyhaline	22%	0.2	0.5	0.7	1.0	1.2	1.4	1.7	1.9	March 1–May 31 Sept 1–Nov 30

Source: USEPA 2003a

a. Based on application of the Equation IV-1 published in USEPA 2003a, $PLW = 100\exp(-K_dZ)$, where the appropriate percent light through water (PLW) criterion value and the selected application depth (see Table 3-6) are inserted and

the equation is solved for K_d . The generated K_d value is then converted to Secchi depth (in meters) using the conversion factor $K_d = 1.45/\text{Secchi depth}$.

The water clarity criteria, applied only during the SAV growing seasons, are presented in terms of the percent ambient light at the water surface extending through the water column and the equivalent Secchi depth by application depth (Table 3-5). The recommended percent light-through-water criteria can be directly measured using a Secchi disk or a light meter. A specific application depth is required to apply and determine attainment of the water clarity criteria (Table 3-6).

SAV restoration acreage goals and water clarity application depths were developed based on historic and recent data on the distribution of SAV (USEPA 2003c). Detailed analyses using that data—including historical aerial photographs—were undertaken to map the distribution and depth of historical SAV beds in the Chesapeake Bay and its tidal tributaries. The analyses led to the adoption of the single best year method that considers historical SAV distributions from the 1930s through the early 1970s and more recent distributions since 1978 to the present mapped through annual SAV aerial surveys of the Bay's shallow-water habitats. Using that method, the CBP and its watershed partners established a Bay-wide SAV restoration goal of 185,000 acres and Bay segment-specific acreage goals (Table 3-6) (USEPA 2003c).

Table 3-6. Chesapeake Bay SAV restoration acreages and application depths—current WQS

Segment description	State	Segment designator	SAV acreage restoration goal	Secchi application depth (meters)
Northern Chesapeake Bay	MD	CB1TF2	12,149	2.0
Northern Chesapeake Bay	MD	CB1TF1	754	1.0
Upper Chesapeake Bay	MD	CB2OH	705	0.5
Upper Central Chesapeake Bay	MD	CB3MH	1,370	0.5
Middle Central Chesapeake Bay	MD	CB4MH	2,533	2.0
Lower Central Chesapeake Bay	MD	CB5MH_MD	8,270	2.0
Lower Central Chesapeake Bay	VA	CB5MH_VA	7,633	2.0
Western Lower Chesapeake Bay	VA	CB6PH	1,267	1.0
Eastern Lower Chesapeake Bay	VA	CB7PH	15,107	2.0
Mouth of Chesapeake Bay	VA	CB8PH	11	0.5
Bush River	MD	BSHOH	350	0.5
Gunpowder River-Upper	MD	GUNOH2	572	2.0
Gunpowder River-Lower	MD	GUNOH1	1,860	0.5
Middle River	MD	MIDOH	879	2.0
Back River	MD	BACOH	340 ¹⁵	0.5
Patapsco River	MD	PATMH	389	1.0
Magothy	MD	MAGMH	579	1.0
Severn River	MD	SEVMH	455	1.0
South River	MD	SOUTMH	479	1.0
Rhode River	MD	RHDMH	60	0.5
West River	MD	WSTMH	238	0.5
Upper Patuxent River	MD	PAXTF	205	0.5
Middle Patuxent River	MD	PAXOH	115	0.5

¹⁵ Proposed revisions to Maryland's water quality standards regulations would revise this figure to 30 acres.

Segment description	State	Segment designator	SAV acreage restoration goal	Secchi application depth (meters)
Lower Patuxent River	MD	PAXMH1	1,459	2.0
Lower Patuxent River	MD	PAXMH2	172	0.5
Lower Patuxent River	MD	PAXMH4	1	0.5
Lower Patuxent River	MD	PAXMH5	2	0.5
Upper Potomac River	MD	POTTF_MD	2,142	2.0
Piscataway Creek	MD	PISTF	789	2.0
Mattawoman Creek	MD	MATTF	792	1.0
Middle Potomac River	MD	POTOH1	1,387	2.0
Middle Potomac River	MD	POTOH2	262	1.0
Middle Potomac River	MD	POTOH3	1,153	1.0
Lower Potomac River	MD	POTMH_MD	7,088	1.0
Upper Potomac River	VA	POTTF_VA	2,093	2.0
Middle Potomac River	VA	POTOH_VA	1,503	2.0
Lower Potomac River	VA	POTMH_VA	4,250	1.0
Upper Rappahannock River	VA	RPPTF	66	0.5
Middle Rappahannock River	VA	RPPOH	4	0.5
Lower Rappahannock River	VA	RPPMH	1,700	1.0
Corrotoman River	VA	CRRMH	768	1.0
Piankatank River	VA	PIAMH	3,479	2.0
Upper Mattaponi River	VA	MPNTF	85	0.5
Lower Mattaponi River	VA	MPNOH	No Data Available	0.5
Upper Pamunkey River	VA	PMKTF	187	0.5
Lower Pamunkey River	VA	PMKOH	No Data Available	0.5
Middle York River	VA	YRKMH	239	0.5
Lower York River	VA	YRKPH	2,793	1.0
Mobjack Bay	VA	MOBPH	15,901	2.0
Upper James River-Upper	VA	JMSTF2	200	0.5
Upper James River-Lower	VA	JMSTF1	1,000	0.5
Appomattox River	VA	APPTF	379	0.5
Middle James River	VA	JMSOH	15	0.5
Chickahominy River	VA	CHKOH	535	0.5
Lower James River	VA	JMSMH	200	0.5
Mouth of the James River	VA	JMSPH	300	1.0
Lynnhaven River	VA	LYNPH	107	0.5
Northeast River	MD	NORTF	89	0.5
Chesapeake & Delaware Canal	MD	C&DOH_MD	7	0.5
Bohemia River	MD	BOHOH	354	0.5
Elk River	MD	ELKOH1	1,844	2.0
Elk River	MD	ELKOH2	190	0.5
Sassafras River	MD	SASOH1	1,073	2.0
Sassafras River	MD	SASOH2	95	0.5
Upper Chester River	MD	CHSTF	230 ¹⁶	0.5

¹⁶ Proposed revisions to Maryland's water quality standards regulations would revise this figure to 1 acre.

Segment description	State	Segment designator	SAV acreage restoration goal	Secchi application depth (meters)
Middle Chester River	MD	CHSOH	77	0.5
Lower Chester River	MD	CHSMH	2,928	1.0
Eastern Bay	MD	EASMH	6,209	2.0
Middle Choptank River	MD	CHOOH	72	0.5
Lower Choptank River	MD	CHOMH2	1,621	1.0
Mouth of Choptank River	MD	CHOMH1	8,184	2.0
Little Choptank River	MD	LCHMH	4,076	2.0
Honga River	MD	HNGMH	7,761	2.0
Fishing Bay	MD	FSBMH	197	0.5
Middle Nanticoke River	MD	NANOH	12	0.5
Lower Nanticoke River	MD	NANMH	3	0.5
Wicomico River	MD	WICMH	3	0.5
Manokin River	MD	MANMH1	4,294	2.0
Manokin River	MD	MANMH2	59	0.5
Big Annemessex River	MD	BIGMH1	2,021	2.0
Big Annemessex	MD	BIGMH2	22	0.5
Middle Pocomoke River	MD	POCOH_MD	22 ¹⁷	0.5
Lower Pocomoke River	MD	POCMH_MD	877	1.0
Lower Pocomoke River	VA	POCMH_VA	4,066	1.0
Tangier Sound	MD	TANMH1_MD	24,683	2.0
Tangier Sound	MD	TANMH2_MD	74	0.5
Tangier Sound	VA	TAHMH_VA	13,579	2

Sources: USEPA 2003c, 2004e; Code of Maryland Title 26 Subtitle 08, Chapter 2, Section 3; Code of Virginia 9 62.1-44.15 3a; VAC 25-260-185; 7 Delaware Code Section 6010; 7 Delaware Administrative Code 7401; District of Columbia Municipal Regulations Title 21, Chapter 11.

Note: This table contains additional split segments beyond the 92 Chesapeake Bay segments listed in Table 3-3 strictly for purposes of applying separate water clarity criteria application depths within the same segment (USEPA 2004e).

3.2 Jurisdictions' Current Chesapeake Bay Water Quality Standards Regulations

Delaware, the District of Columbia, Maryland, and Virginia each has adopted WQS consistent with EPA's published Chesapeake Bay water quality criteria, assessment procedures, and tidal water designated uses in its respective WQS regulations (Table 3-7). In some cases, a jurisdiction also has adopted more jurisdiction-specific designated uses or criteria or both; those cases are briefly described below.

¹⁷ Proposed revisions to Maryland's water quality standards regulations would revise this to be a no-grow zone.

Table 3-7. Links for accessing the current WQS regulations for Delaware, the District of Columbia, Maryland, and Virginia

Jurisdiction	WQS regulations URL address
Delaware	7 Delaware Code Section 6010; 7 Delaware Administrative Code 7401 < http://www.epa.gov/waterscience/standards/wqslibrary/de/de_3_wqs.pdf >
District of Columbia	DC Municipal Regulations Title 21, Chapter 11 < http://www.epa.gov/waterscience/standards/wqslibrary/dc/dc_3_register.pdf >
Maryland	Code of Maryland Title 26 Subtitle 08, Chapter 2 < http://www.epa.gov/waterscience/standards/wqslibrary/dsd.state.md/md-ch2-quality-20051130.pdf.us/comar/subtitle_chapters/26_Chapters.htm >
Virginia	Code of Virginia 9 62.1-44.15 3a; VAC 25-260 Virginia WQSs < http://www.deq.virginia.gov/wqs/ > OR < http://epa.gov/waterscience/standards/wqslibrary/va/va_3_wqs.pdf >

3.2.1 District of Columbia

Table 3-8 summarizes the District of Columbia's designated uses for its surface waters. The District of Columbia has adopted EPA's narrative chlorophyll *a* water quality criteria but also adopted the Bay numeric chlorophyll *a* water quality criteria shown in Table 3-9 with respect to the District of Columbia's tidal Class C waters. Those numeric chlorophyll *a* criteria are subject to this Chesapeake Bay TMDL (see Table 2-1).

Table 3-8. District of Columbia designated uses for surface waters

Class of water	Description
A	Primary contact recreation
B	Secondary contact recreation and aesthetic enjoyment
C	Protection and propagation of fish, shellfish, and wildlife
D	Protection of human health related to consumption of fish and shellfish
E	Navigation

Source: District of Columbia Municipal Regulations Title 21, Chapter 11

Table 3-9. Numeric criteria for the District of Columbia's tidally influenced waters

Constituent	Numeric criteria	Temporal application	Designated use
Dissolved oxygen	7-day mean ≥ 6.0 mg/L Instantaneous minimum ≥ 5.0 mg/L 30-day mean ≥ 5.5 mg/L 7-day mean ≥ 4.0 mg/L Instantaneous minimum ≥ 3.2 mg/L (At temperatures greater than 29 °C, in tidally influenced waters, an instantaneous minimum dissolved oxygen concentration of 4.3 mg/L will apply)	February 1– May 31 June 1– January 31	C
Secchi depth	0.8 m (seasonal segment average)	April 1– October 31	C
Chlorophyll <i>a</i>	25 µg/L (season segment average)	July 1– September 30	C

Source: District of Columbia Municipal Regulations Title 21, Chapter 11

Note: µg/L = micrograms per liter

3.2.2 Delaware

The EPA-published Chesapeake Bay criteria and designated use documents and subsequent addenda apply to the tidal Nanticoke River and Broad Creek in Delaware, both of which are subject to this Chesapeake Bay TMDL (see Table 2-1). Delaware has adopted EPA's narrative chlorophyll *a* water quality criteria.

Delaware has adopted all the EPA-published Chesapeake Bay criteria and designated use documents and subsequent addenda listed in Table 3-1 by reference into its WQS regulations. As a result, no WQS changes are pending in Delaware.

3.2.3 Maryland

Maryland has adopted into its WQS regulations all the EPA-published Bay criteria, assessment procedures, and designated uses described previously to apply to all Chesapeake Bay, tidal tributary, and embayment waters of Maryland subject to this Chesapeake Bay TMDL. Maryland has adopted EPA's narrative chlorophyll *a* water quality criteria.

Several tidal Bay segment-specific applications of DO criteria are unique to Maryland. In the middle-central Chesapeake Bay segment (CB4MH), restoration variances¹⁸ of 7 and 2 percent apply to the application of the deep-water and deep-channel designated use DO criteria, respectively. In the Patapsco River segment (PATMH), a restoration variance of 7 percent applies to the application of the deep-water criteria (COMAR 26.08.02.03-3(c)(8)(e)(vi)). Such restoration variances are consistent with EPA-published guidance (USEPA 2003c) and were approved by EPA on August 29, 2005.

3.2.4 Virginia

The EPA-published Bay criteria, assessment procedures, and designated uses described previously apply to all Chesapeake Bay, tidal tributary, and embayment waters of Virginia and are subject to this Chesapeake Bay TMDL. The narrative chlorophyll *a* criteria guidance published by EPA (USEPA 2003a) as adopted by Virginia are applicable to Virginia's Bay tidal waters. Virginia also adopted the segment-specific numeric chlorophyll *a* criteria for the tidal James River listed in Table 3-10 into its WQS regulations. The criteria are based on various scientific lines of evidence published the original EPA 2003 Bay criteria document (USEPA 2003a) with additional river-specific considerations (VADEQ 2004). EPA approved the WQS regulations on June 27, 2005.

Virginia has additional site-specific DO and chlorophyll *a* criteria. In the tidal Mattaponi (MPNTF, MPNOH) and Pamunkey (PMKTF, PMKOH) river segments, because of the seasonal lower DO concentration from the natural oxygen-depleting processes present in surrounding tidal wetlands, a site-specific criterion of greater than or equal to 4 mg/L 30-day mean DO (9 VAC 25-260-185) is warranted and is consistent with the EPA-published criterion (USEPA 2004a).

¹⁸ A restoration variance is the percentage of allowable exceedance based on water quality modeling incorporating the best available data and assumptions. The restoration variances are temporary and will be reviewed at a minimum every 3 years, as required by the CWA and EPA regulations. The variances could be modified on the basis of new data or assumptions incorporated into the water quality model. COMAR 26.08.02.03-3(C)(8)(h).

Table 3-10. Segment-specific chlorophyll a criteria for Virginia's tidal James River waters

Designated use	Chlorophyll a criterion (µg/L)	Chesapeake Bay segment	Temporal application
Open-Water	10	Upper James River-Upper (JMSTF2)	March 1–May 31
	15	Upper James River-Lower (JMSTF1)	
	15	Middle James River (JMSOH)	
	12	Lower James River (JMSMH)	
	12	Mouth of the James River (JMSPH)	
	15	Upper James River-Upper (JMSTF2)	July 1–September 30
	23	Upper James River-Lower (JMSTF1)	
	22	Middle James River (JMSOH)	
	10	Lower James River (JMSMH)	
	10	Mouth of the James River (JMSPH)	

Source: Code of Virginia 9 section 62.1-44.15 3a; VAC 25-260

Note: µg/L = micrograms per liter

3.3 Jurisdictions' Pending Revisions to Chesapeake Bay Water Quality Standards Regulations

Maryland, Virginia, and the District of Columbia are each in the process of proposing the modification of their respective WQS regulations directly relevant to the Bay TMDL.

3.3.1 District of Columbia

The District of Columbia has adopted the 2003 Chesapeake Bay water quality criteria document (USEPA 2003a) into its WQS regulations. The District of Columbia has proposed adoption of the EPA-published 2004, 2007, 2008, 2010 Bay criteria addenda (USEPA 2004a, 2007a, 2007b, 2008a, 2010a) by reference. The proposal is pending public review and EPA approval.

3.3.2 Delaware

Delaware already has adopted the EPA-published 2010 Bay criteria addendum into its WQS regulations by reference. Therefore, no revisions to Chesapeake Bay WQS regulations are pending in Delaware.

3.3.3 Maryland

Maryland has adopted most of the EPA-published Chesapeake Bay criteria and designated use documents and subsequent addenda listed in Table 3-1 by reference into its WQS regulations. Maryland has proposed adoption of the EPA published 2010 Bay criteria addendum (USEPA 2010a) by reference. The proposal is pending public review and EPA approval.

Maryland also has proposed the following amendments to its WQS regulations: adopting the EPA-published 2010 Bay criteria addendum; adopting a 14 percent restoration variance for the lower Chester River segment (CHSMH) deep-channel DO criteria application; adopting a site-specific 4 mg/L 30-day mean DO criterion for the upper and middle tidal Pocomoke River (POCTF, POCOH_MD) segments; applying the deep-water designated use, in the presence of observed pycnoclines, in the South (SOUH), Severn (SEVMH) and Magothy (MAGMH) river segments; a 30-acre SAV restoration acreage for the Back River (BACOH) segment; a 1-acre SAV restoration acreage for the upper Chester River (CHSTF) segment; and recognizing the

middle Pocomoke River segment (POCOH_MD) as an SAV no-grow zone (Appendix R-3). The proposal is pending public review and EPA approval.

3.3.4 Virginia

Virginia has adopted most of the EPA-published Chesapeake Bay criteria and designated use documents and subsequent addenda listed in Table 3-1 by reference into its WQS regulations. Virginia has proposed adoption of the EPA-published 2007, 2008, and 2010 Bay criteria addendum (USEPA 2010a) by reference. The proposal is pending public review and EPA approval.

3.4 Assessing Attainment of Chesapeake Bay Water Quality Standards

The Bay criteria assessment approach is designed to protect the living resources as defined by the designated uses (USEPA 2003a). The criteria levels themselves were largely based on scientific studies performed in laboratory settings or under controlled field conditions. The criteria establish the level of a given habitat condition that living resources need for survival. They do not account for many other environmental factors that could affect survival.

For all three tidal states and the District of Columbia, attainment of each jurisdiction's Chesapeake Bay WQS is determined by applying the same set of assessment procedures published in the original 2003 Chesapeake Bay criteria document (USEPA 2003a) and subsequent published addenda (USEPA 2004a, 2007a, 2007b, 2008a, 2010a) (see Table 3-1). Those consistent sets of criteria assessment procedures are formally adopted into each jurisdiction's WQS regulations by reference.

3.4.1 Defining Total Exceedances

Criteria attainment for DO, water clarity, and chlorophyll *a* is assessed in terms of the spatial and temporal extent of criterion exceedances—what volume or surface area of the Bay segment exceeds a given criteria and for how much time during the assessment period (USEPA 2003a, 2004a). The allowable frequency with which criteria can be violated without a loss of the designated use is also considered. For each listing cycle, assessments are based on monitoring data collected over a 3-year period in each spatial assessment unit. Spatial assessment units are defined by Chesapeake Bay segments and applicable designated uses. Such assessment of the criteria as further described below is designed to provide reliable protection for the associated refined aquatic life use.

The spatial exceedances of criteria are determined using a grid cell-based data interpolation software application that enables estimation of water quality values for the entire Bay using monitored data at specific points (USEPA 2003a, 2007a). The interpolated data are compared to water quality criteria on a cell by cell basis, and the percent of surface area or volume exceeding the criterion in each spatial assessment unit is calculated. The percent spatial exceedances for each assessment unit are then compiled for each monitoring event conducted during the 3-year monitoring period.

The temporal extent of exceedances is determined by calculating the probability that an observed percent exceedance will be equaled or exceeded. To calculate that probability, the percent of

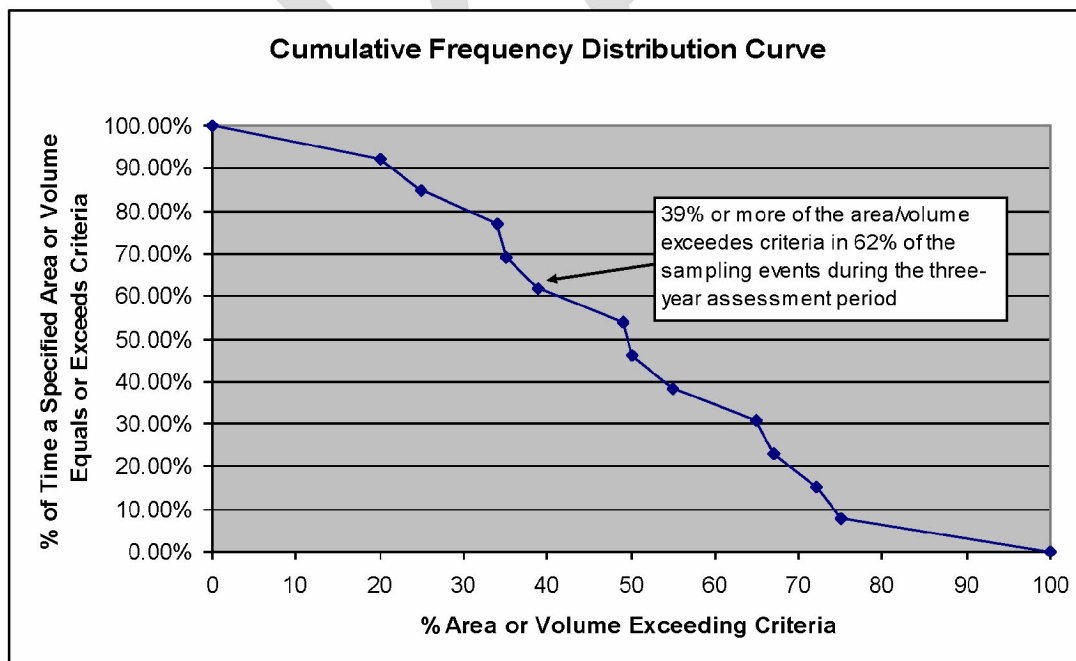
spatial exceedances are sorted and ranked, and a cumulative probability is calculated for each spatial exceedance value (USEPA 2003a). An example is shown in Table 3-11.

Table 3-11. Estimated percent spatial criteria exceedances and associated cumulative probabilities

Period of data	Percent area/volume exceeding criteria (spatial)	Rank	Cumulative probability [rank / (n + 1)] (temporal)
	100		0.00%
June 1998	75	1	7.69%
March 1998	72	2	15.38%
May 1999	67	3	23.08%
May 1998	65	4	30.77%
April 1998	55	5	38.46%
June 2000	50	6	46.15%
March 1999	49	7	53.85%
April 2000	39	8	61.54%
May 2000	35	9	69.23%
Apr 1999	34	10	76.92%
June 1999	25	11	84.62%
March 2000	20	12	92.31%

Source: USEPA 2003a

The spatial and temporal exceedances can be graphically illustrated by plotting the cumulative frequency distribution (CFD) curve, which is a plot of the temporal exceedance values on the Y-axis versus the spatial exceedance values on the X-axis (Figure 3-3) (USEPA 2003a, 2007a; STAC 2006).



Source:

USEPA 2003a

Figure 3-3. Example cumulative frequency distribution (CFD) curve.

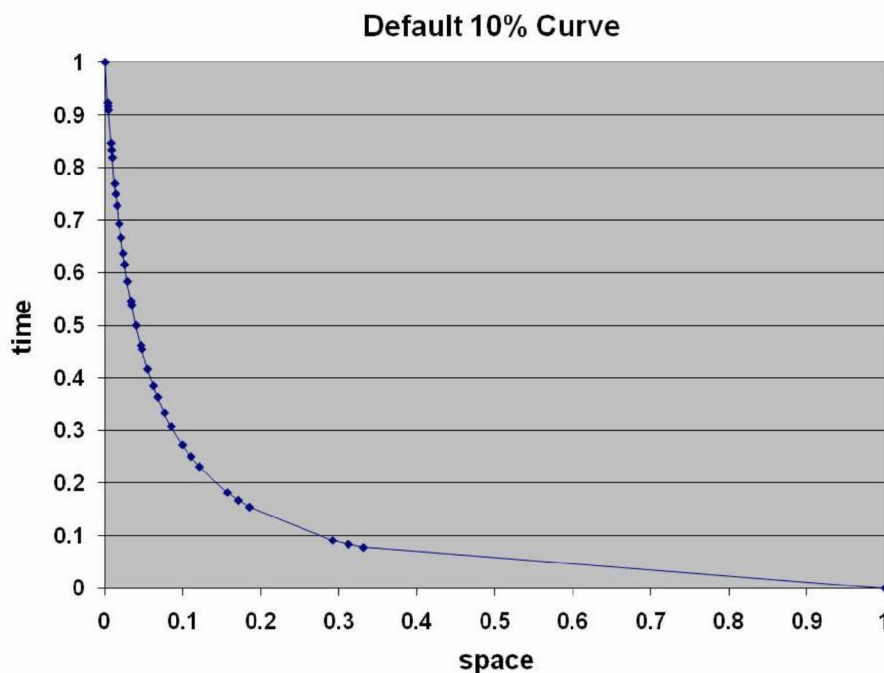
3.4.2 *Defining Allowable Exceedances*

Reference curves were developed to provide a scientifically based, direct measure of the allowable criteria exceedances (USEPA 2003a). Those allowable exceedances are defined to be those that last a short enough time or cover a small enough volume/surface area to have no adverse effects on the designated use. It is assumed that the designated uses can be attained even with some limited level of criteria exceedances and thus, the reference curves define those criteria exceedances deemed to be allowable—chronic in time but over small volumes/surface areas, or infrequent occurrences over large volumes/surface areas. Exceedances that occur over large areas of space and time would be expected to have significant detrimental effects on biological communities, which would imply nonattainment of designated uses.

Reference curves are used in conjunction with the CFD to illustrate the time and space during which a given criteria can be allowably exceeded without resulting in harm to the designated use. For assessment purposes, two types of reference curves are used: a biological reference curve and a 10 percent default reference curve.

Biological reference curves are CFDs developed for a given criterion in areas for which monitoring data are available and in which healthy aquatic communities exist (USEPA 2003a). They represent the range of conditions that can reasonably be expected in a healthy community. As a result, the biological reference curve can be used to provide an understanding of what level of criteria exceedances are allowable without losing support of the designated use. Given the Bay's nutrient-enriched status, appropriate reference sites are limited. Biological reference curves have been published for and are used to assess allowable exceedances for the deep-water DO criteria (USEPA 2010a) and the water clarity criteria (USEPA 2003a).

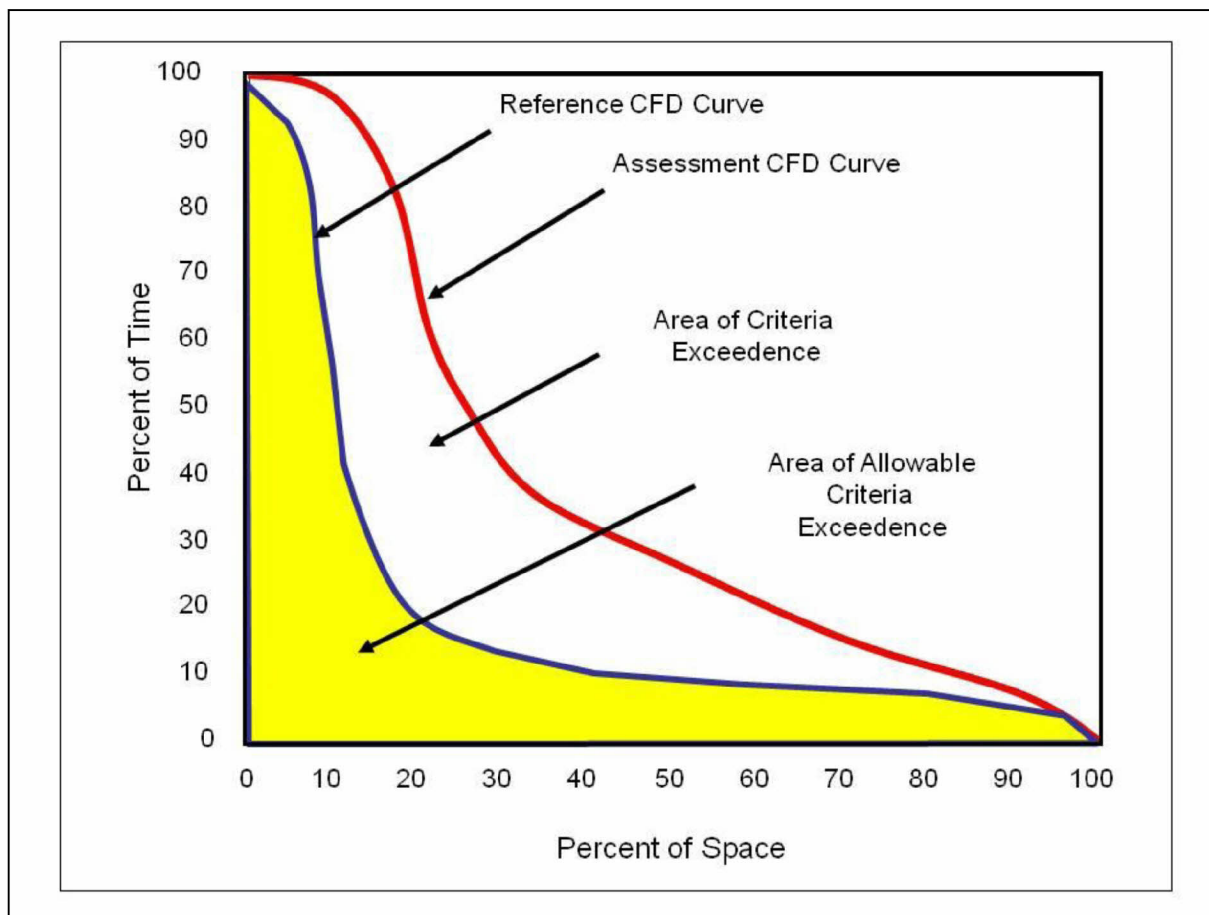
In some cases, developing a biologically based reference curve is not possible because of a lack of data describing the health of the relevant species or biological communities and lack of appropriate reference sites. Such cases require a different approach. EPA recommends using a default reference curve in situations for which a biologically based reference curve is unavailable (USEPA 2007a). The default reference curve is defined as a hyperbolic curve that encompasses no more than 10 percent of the area of the CFD graph (percent of space multiplied by percent of time) (USEPA 2007a, page 13, Figure II-4 and Equation 1) (Figure 3-4).



Source: USEPA 2007a

Figure 3-4. Default reference curve used in the attainment assessment of Chesapeake Bay water quality criteria for which biologically based reference curves have not yet been derived.

Once the CFD curve for a spatial assessment unit is developed from monitoring data (also referred to as the assessment curve), it is compared to the appropriate reference curve. The area on the graph above the reference curve and below the assessment curve is considered a non-allowable exceedance. Values on the assessment curve falling below the reference curve are considered allowable exceedances (Figure 3-5).



Source: USEPA 2003a

Figure 3-5. Example reference and assessment curves showing allowable and non-allowable exceedances

3.4.3 Assessing Criteria Attainment

Dissolved Oxygen Criteria Assessment

EPA published DO criteria protective of migratory and spawning, open-water, deep-water, and deep-channel designated use habitats (

Table 3-4) (USEPA 2003a). DO criteria were established for Chesapeake Bay that varied in space and time to provide levels of protection for different key species and communities. The criteria were also designed around several lengths of time to reflect the varying oxygen tolerances for different life stages (e.g., larval, juvenile, adult) and effects (e.g., mortality, growth, behavior).

The DO criteria include multiple components, including a target DO concentration, the duration of time over which the concentration is averaged, the designated use area where the criterion applies, the protection provided, and the time of year when the criterion applies (USEPA 2003a, 2003c). The four tidal Bay jurisdictions adopted these DO criteria into their respective WQS regulations.

Assessing DO criteria attainment is challenging because of the complexity of both the criteria and the Bay itself. To fully assess all the criteria components, data needed to be collected at a spatial intensity that adequately represent the four designated use habitats of Chesapeake Bay tidal waters at different times of the year (USEPA 2003c, 2004e). Similarly, data were collected during all the applicable seasons and at frequencies sufficient to address the various criteria duration components. The different DO criteria apply to different designated use areas and multiple criteria apply to the same designated use area. The DO criteria components also apply over different periods to protect species during critical life stages or during particularly stressful times of the year. To fully assess each DO component in each designated use habitat over the appropriate periods will require an extensive monitoring program and a detailed assessment methodology. The CBP conducts extensive water quality and living resource monitoring throughout the Bay tidal waters (CBP 1989a, 1989b; MRAT 2009). The existing Bay water quality monitoring was not sufficient to cover all the criteria components, however, and some details in the assessment methodology remain unresolved (USEPA 2007a; MRAT 2009).

The DO criteria include 30-day, 7-day, and 1-day means along with an instantaneous minimum. The CBP partners have the capacity (data, assessment methodology) to assess only the 30-day mean open-water and deep-water DO criteria and, in the case of the deep-channel use, the instantaneous minimum DO criteria (USEPA 2003a, 2004a, 2007a, 2008a, 2010a). The remaining DO criteria are not assessed because the existing water quality monitoring programs and the published assessment methodologies are not yet adequate for full assessment.

Evaluation of Chesapeake Bay water quality/sediment transport model outputs have provided clear evidence that the 30-day mean open-water and deep-water and the instantaneous minimum deep-channel DO criteria are the criteria driving determination of nutrient loadings supporting attainment all the open-water (30-day mean, 7-day mean, instantaneous minimum), deep-water (30-day mean, 1-day and instantaneous minimum), and deep-channel (instantaneous minimum) DO criteria.

For both open-water and deep-water designated uses, the 30-day mean criteria had the highest nonattainment in all three scenarios (Figure 3-6). The 30-day mean open-water and deep-water criteria are, therefore, protective of the other two non-assessed dissolved oxygen criteria (open-water 7-day and instantaneous minimum, deep-water 1-day mean and instantaneous minimum) on average for the mainstem Bay segments. The deep-channel designated use has only one dissolved oxygen criterion, and it is currently assessed using monitoring data. The deep-channel criterion is also more protective, based on the levels of nonattainment recorded in Figure 3-6, than the deep-water and open-water criteria. The analyses documented in Appendix D provide clear evidence the 30-day mean open-water and deep-water dissolved oxygen criteria and the deep-channel instantaneous minimum criterion are the most protective criteria across all Bay segments and designated uses.

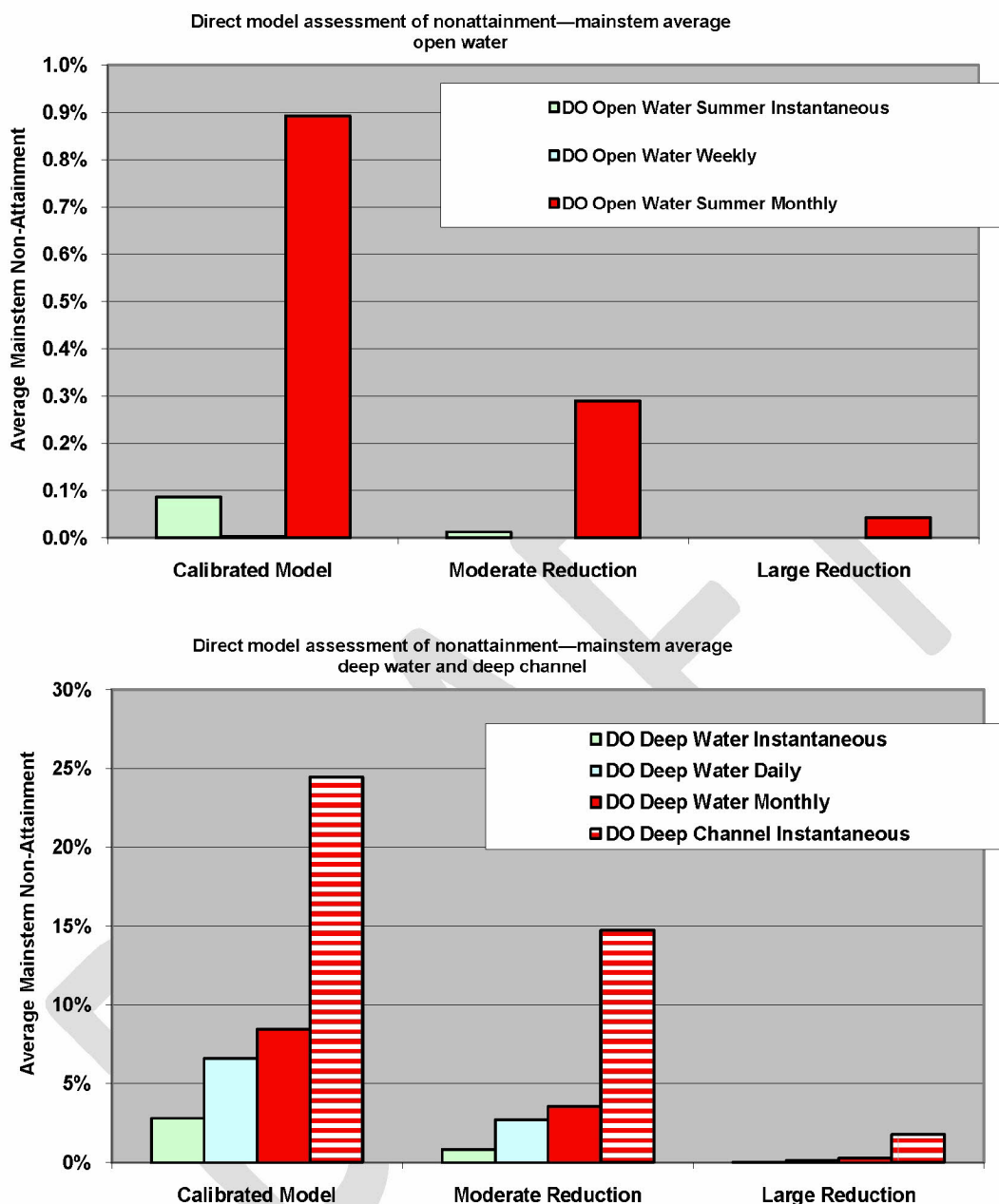


Figure 3-6. Direct model assessment of open water (a), and deep water and deep channel (b) criteria.

Chlorophyll *a* Criteria Assessment

The procedures described in USEPA 2007b, and further refined in USEPA 2010a, apply to assessing Virginia's tidal James River and the District of Columbia's tidal waters numeric chlorophyll *a* criteria.

To assess attainment of the Virginia and District of Columbia's adopted numerical chlorophyll *a* concentration-based criteria, it was necessary to establish a reference curve for use in the CFD criteria assessment (USEPA 2003a, 2007a). In the case of the numerical chlorophyll *a* criteria where a biologically based reference curve is not available (USEPA 2007b), EPA

recommended—and Virginia and the District of Columbia adopted—using the default reference curve originally described in USEPA 2007a and illustrated in Figure 3-4.

The jurisdiction-adopted, concentration-based, chlorophyll *a* criteria values are threshold concentrations that should be exceeded infrequently (e.g., < 10 percent) because a low number of naturally occurring exceedances occur even in a healthy phytoplankton population (USEPA 2007b). The assessment of chlorophyll *a* criteria attainment, therefore, uses the CFD-based assessment method described earlier that applies the default reference curve. Such concentration-based Chesapeake Bay chlorophyll *a* criteria apply only to those seasons and salinity-based habitats for which they were defined to protect against applicable human health and aquatic life impairments (USEPA 2007b). Each season—Spring (March 1–May 31) and Summer (July 1–September 30)—was assessed separately to evaluate chlorophyll *a* criteria attainment.

The chlorophyll *a* criteria are based on seasonal mean of observed chlorophyll data. The observed data are first transformed by taking the natural logarithm and then interpolated spatially to equally spaced points (representing interpolator cells) within the designated use area for each monitoring cruise. The interpolated value of each cell is averaged in time across the entire season, and then the spatial violation rate is calculated as the fraction of interpolator cells in a designated use area that fails the appropriate criterion (USEPA 2010a).

SAV/Water Clarity Criteria Assessment

Water clarity criteria and SAV restoration acreages are used to define attainment of the shallow-water bay grass designated use in Chesapeake Bay, its tidal tributaries, and embayments (USEPA 2003a, 2003c). EPA published three measures for assessing attainment of the shallow-water SAV designated use for a Chesapeake Bay segment (USEPA 2007a):

1. Measure SAV acreage in the Bay segment from overflight data mapping analysis and compare with the SAV restoration goal acreage for that Bay segment (USEPA 2003b).
2. Measure water clarity acreage on the basis of routine water quality mapping using data from the Chesapeake Bay shallow-water monitoring program and, combined with measured acres of SAV, compare with the calculated water clarity acres for that segment (USEPA 2007a).
3. Measure water clarity criteria attainment on the basis of the CFD assessment methodology, again using shallow-water monitoring program data (USEPA 2003a, 2003c, 2007a, 2008a).

Without sufficient shallow-water monitoring data to determine the available water clarity acres (measurement 2 above) or to assess water clarity criteria attainment using the CFD-based procedure (measurement 3 above), EPA recommends that the jurisdictions assess shallow-water Bay grass designated use attainment using the acres of mapped SAV (measurement 1 above) (USEPA 2003a, 2003b, 2007a, 2008a).